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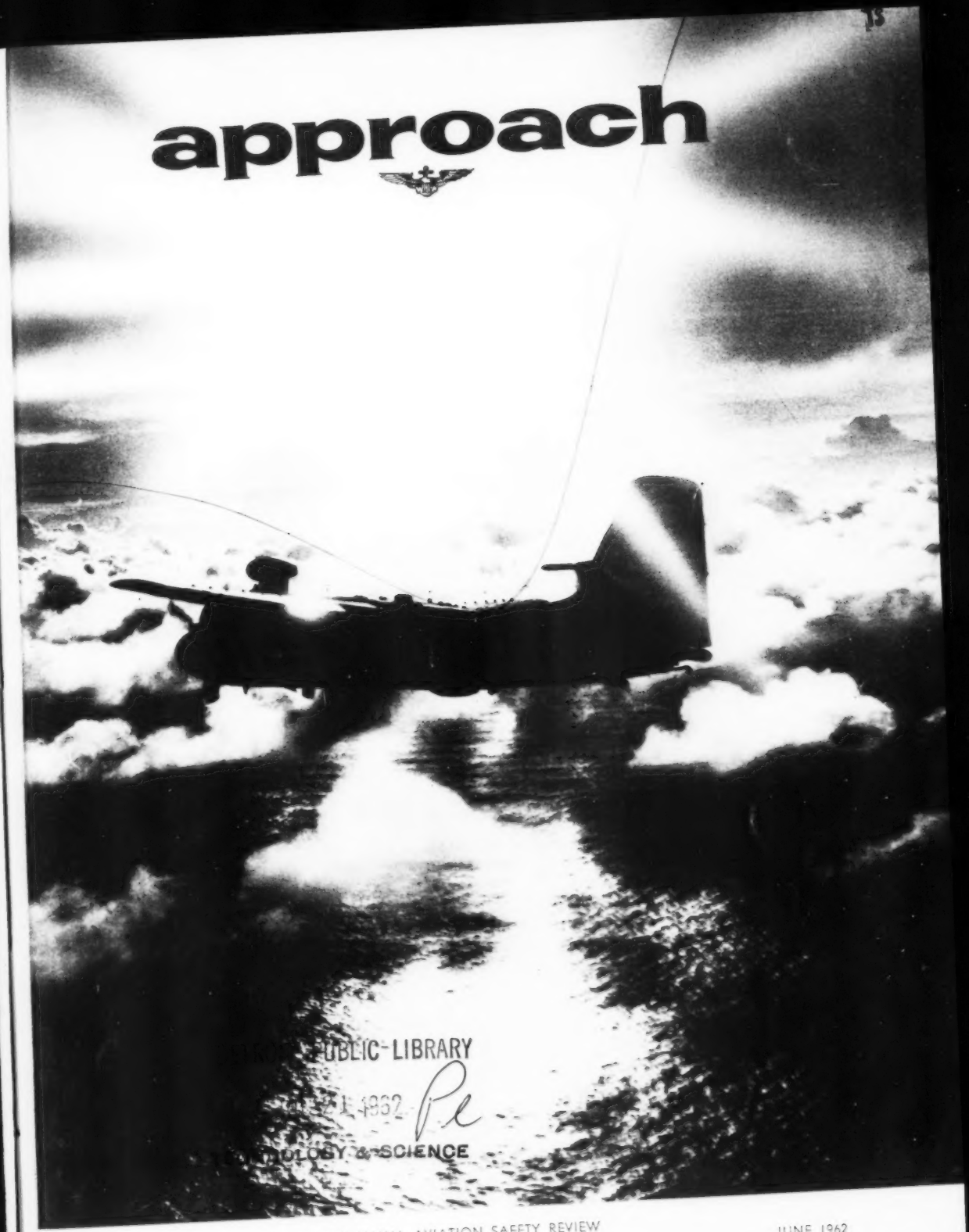

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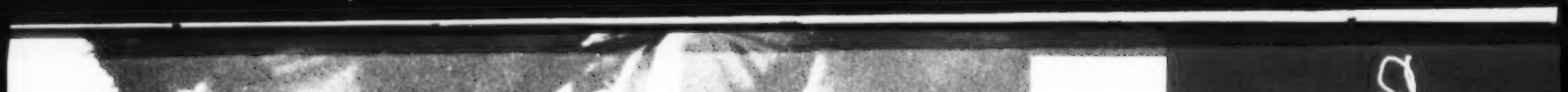
THE NAVAL AVIATION SAFETY REVIEW JUNE 1962

NAVWEPS 00-75-510

The sentence "Mary had a little lamb." was dictated to the subject of a pressure chamber demonstration of the deterioration of writing skill at a hypoxia-producing altitude.

MARY Hod A LITTLE LOMP
Mary Hod A LITTLE LOMP



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**No matter whether you fly transports, jets or props, hypoxia is a threat to you and your aircraft. Strict observance of oxygen discipline is vital on all flights above 10,000 feet, night flights above 5000 feet and in jets from takeoff to landing. Many persons are not aware that the use of oxygen at altitude can lessen the burden on the heart, an important factor in the well-being of pilots and crewmen who are 40-ish.**

**Hypoxia cases involving a patrol plane crewman, a jet pilot, a test pilot wearing the full pressure suit, a 45-year-old transport pilot who suffered a heart attack in flight and an AD pilot whose smoking aggravated his borderline hypoxia during a night flight which terminated in a wheels-up landing are discussed here. . . .**

On a clear morning in October, a patrol aircraft departed its base on a scheduled photographic mission at 25,000 feet. Preflight was normal . . . the gaseous oxygen supply read 1200 psi. All crewmembers reported their oxygen systems operating properly.

Cruising altitude to the photo area was 5000 feet. After level off, the pilot briefed the crew: proceed to the first check point, then climb to 25,000 feet with the crew on oxygen.

Around noon, the radio/radar operator, who is the subject of this episode, fixed lunch for the crew. For convenience we'll call him "Jones."

Shortly after 1230, the aircraft reported over a checkpoint and began the climb to 25,000, to the photo area 73 miles northwest. Before passing through 12,000 feet, the pilot directed all crewmembers to don and check their oxygen masks. All reported OK. The pilot directed Jones to come forward from the radio position to operate the radar. Jones did so, connecting himself to the radar operator's oxygen outlet.

When the aircraft reached altitude, the navigator's D. R. position showed that they had overshot the first flight line. The pilot flew a wind star, then decided to back track and position the plane by radar for the first photo run. Jones monitored the radar and reported 30 miles directly abeam of the beginning of the photo line. The pilot directed the photographer to begin shooting. The pilot checked with the photographer every five minutes or so; he could see all the other crewmembers.

The crew finished the first photo flight line and the aircraft turned left to intercept the second flight line. As the navigator told the pilot to hold the cross leg for a specified time before turning into the second flight line, Jones reported that he was going aft to the radio station, a distance of 15 feet across a fuel spar. The plane commander saw Jones plug in his oxygen hose, then turned back to scan his instruments. When he turned again to observe Jones, he could not see him. Two radio checks were unanswered, the navigator reported he could not see Jones either and the plane captain went aft to check.

### Slumped Unconscious

The plane captain found Jones slumped unconscious on the deck at the radio station. His oxygen mask was on his face and his oxygen was plugged into the radioman's oxygen regulator, but *he had turned on the oxygen flow for the regulator for the bunk space.*

The plane captain immediately turned on the oxygen, set the regulator for 100% oxygen flow and opened the safety pressure valve. The pilot began an immediate emergency descent at a rate of 4000 to 5000 feet per minute to 15,000 feet. At 15,000 feet, the rate of descent was slowed. The copilot went aft to assist the plane captain and the navigator in their attempt to revive Jones.

As the oxygen was turned ON, Jones took two deep gasps and then was either apneic (a state in which breathing temporarily ceases following forced breathing) or had very shallow respiration. After descent to a safe altitude he was brought forward and wrapped in blankets. Because he seemed unable to breathe adequately on his own, he was given mouth to mouth artificial respiration by the copilot.

### Begins to Recover

Ten minutes passed before there was a noticeable change in Jones' breathing and he began to move. The copilot continued artificial respiration for an additional five minutes at the end of which Jones seemed to be breathing normally. When he

was put on 100% oxygen again he fought the crew's attempts to keep the mask on his face.

The pilot informed base radio of the situation and that the aircraft was returning as rapidly as possible.

As Jones' condition improved, he began to kick and struggle so violently that his legs had to be strapped down to keep him calm. He continued to fight the oxygen mask. After about an hour, he began to open his eyes, pull the mask from his face and yell. The only words the crew could understand were, "Why don't you leave me alone?" Gradually, he became quieter, struggled less and stopped fighting the oxygen mask. After landing, when the flight surgeon entered the aircraft, Jones was quite calm. He was carried off the aircraft strapped to a stretcher and was taken by helicopter to the dispensary.

### Admitted to Dispensary

On admission to the dispensary, Jones was unable to give any case history and his speech was garbled. The doctor's report described him as "markedly stuporous, uncooperative and disoriented." In the hospital he gradually improved and, when awakened 10 hours post mishap, he was recovered except for a mild generalized headache. His headache was gone the following morning. He has amnesia for the events from the time he plugged into the radioman's oxygen regulator until he woke up in sick bay that evening.

The investigation board was of the opinion that "Jones" might have been hypoxic before connecting his mask to the radioman's regulator.

The entire mishap could have been prevented if the aircraft had been equipped with walk-around oxygen bottles. The commanding officer stated in his endorsement that "standard operating procedures have been reviewed and strengthened by incorporating adequate instructions in checking oxygen equipment and the use of walk-around bottles requiring supplementary oxygen."

The "Jones" case just described is a classic example of the rapidity with which oxygen deprivation at altitude can incapacitate a man. Fortunately this man's life was saved by his fellow crewmembers' swift reaction to the emergency.

### Hypoxia Fatal to Jet Pilot

When a pilot is flying alone, hypoxia can lead to tragedy. The following account describes the events preceding the fatal crash of a jet pilot. Although hypoxia cannot be established absolutely as the cause of this accident, the taped transmissions between pilot, wingman and group personnel are strong evidence in support of the hypoxia theory.

The accident occurred on a routine fam and instrumentation checkout. *Takeoff plus 6 minutes*: the pilot's voice became noticeably weaker. Altitude was 18,000. *Takeoff plus 7.5 minutes*: the pilot reported, that he had neither emergency oxygen, or normal oxygen at an altitude of 23,000 feet. *Takeoff plus 8.5 minutes*: In response to a direction from the chase pilot the pilot reported in a thick weak voice. Heavy breathing was heard with the mike button depressed. Altitude at this time was 24,000 feet. *Takeoff plus 9.5 minutes*: at an altitude of 27,000 feet the pilot made a last garbled transmission in a slow, thick voice in response to the chase pilot's command to push over and descend.

The aircraft continued to climb to approximately 32,000 feet at which point it entered a right descending spiral which terminated in the crash.

### No Pressure Indication

At no time during the flight was there an indication of pressure oxygen flowing into the pilot's mask. As confirmed by tape tests made by investigators, pressure oxygen flowing past the mi-

### Testimonial

**The following is a verbatim excerpt from a book called *Air Service Medical* published by the Government Printing Office in 1919. The speaker quoted is a Capt. P——, a pilot "who has been flying at an average height of 20,000 feet."**

**"Before the oxygen apparatus was used I used to suffer a great deal from flying at high altitudes. I would notice a palpitation of my heart not only in the air at this high altitude but also on the ground for a period of 24 hours after flight. I would have a bad headache not only in the air but also after coming down. This would last from five to six hours. I used to get this palpitation of the heart and headache when I would fly over 16,000 feet; I would also feel 'rotten and done up,' and as time went on it would become so bad I was so tired I could not sleep Monday afternoon, Monday night, or all Tuesday, and I would have my first sleep on Tuesday night. I do not know how to explain why I could not sleep; it was apparently not in any way due to 'nervousness.'**

**"Since I have used the oxygen apparatus, I have had no palpitation, no headache, no fatigue at all, and I sleep normally."**

crophone while the pilot is transmitting makes a distinctive sound.

As mentioned earlier, hypoxia is strongly suspected but cannot be definitely established as a causal factor. Considered as possible causes of the suspected hypoxia were mechanical malfunction or failure of the cabin pressurization system, the oxygen system, the oxygen mask exhalation valve or the oxygen regulator.

Depletion of the oxygen and subsequent hypoxia were implicated as the cause of another fatal jet crash. The pilot was on the return leg of the flight after delivering a passenger to his destination. The aircraft had been refueled, but there was no record of oxygen servicing. The pilot apparently made no attempt to eject before the crash.

### Possible Sequence of Events

Although the sequence of events cannot be positively determined, evidence indicates the following: When the oxygen pressure reached zero and the pilot could not inhale (100% oxygen would be provided by the regulator at this altitude), he removed his mask, throttled back and pushed over to reach a lower altitude. Within 8 to 10 seconds he succumbed to hypoxia and was unable to maintain control of his aircraft.

Hindsight is easier than foresight, but this accident could have been prevented *IF*:

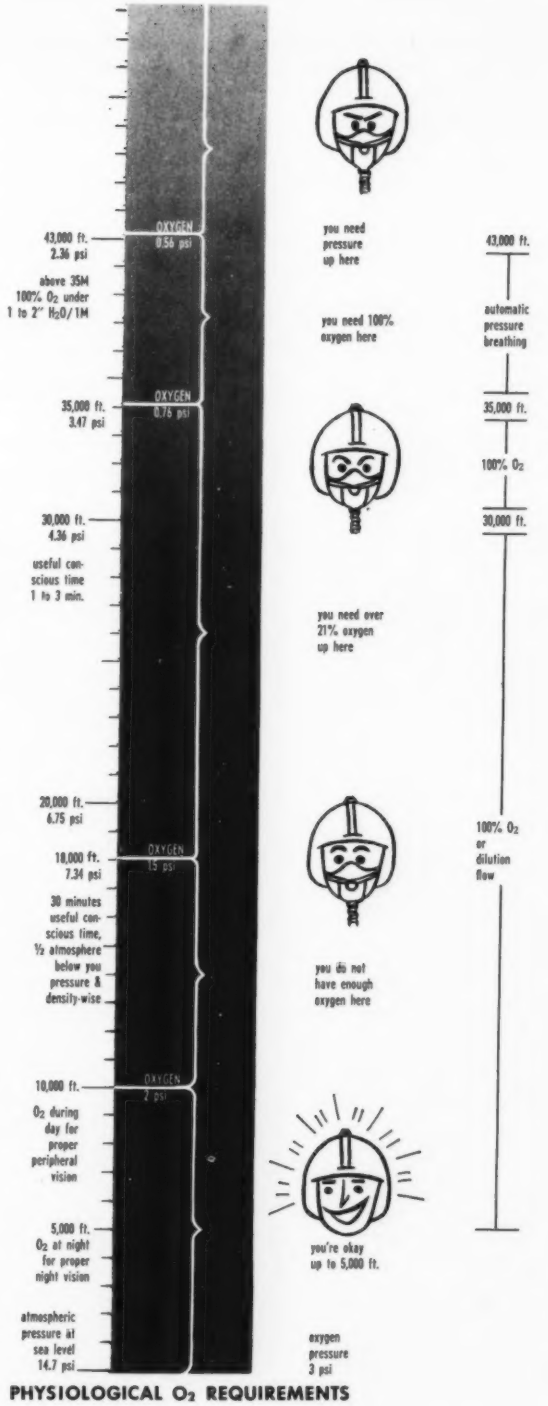
- . . . the servicing crew at the destination base had filled the oxygen system.
- . . . the pilot had detected the lack of oxygen service in his preflight of the aircraft.
- . . . the pilot had actuated the bailout oxygen bottle for an 8 to 10 minute emergency oxygen supply.

Another fact which came to light from the passenger's statement during the investigation was that both he and the pilot experienced symptoms of dysbarism on the initial flight at 37,000 feet. They did not descend to a lower altitude or report this at their destination. On the return flight the pilot reported at an even higher altitude—40,000 feet. At this altitude, dysbarism would considerably reduce the pilot's time of useful consciousness after the exhaustion of his oxygen supply.

### Test Pilot Experiences Hypoxia

All pilots and crewmen should be familiar with the symptoms of hypoxia and should be aware that hypoxia impairs judgment. In a recent incident a pilot, wearing a full pressure suit on an F4H test flight, aborted the flight because he was not feeling well. His symptoms and subsequent investigation implicated hypoxia.

The pilot reported becoming confused and ex-




**PHYSIOLOGICAL $O_2$ REQUIREMENTS**

periencing blurred vision at 40,000 feet. After depressing the face plate seal release button and opening the face plate of his full pressure suit helmet, he descended to 10,000 feet and returned to base.

Here is his recollection of his experience:

"Takeoff and climb to 40,000 feet were normal. Upon leveling off at 40,000 I began to notice a vague funny feeling. Oxygen quantity indicated approximately 8.5 liters. Cabin pressure was 16,000 feet. I could feel some air movement at the upper right temple portion of the face seal and tightened the seal. I began to get indications of blurred vision which I attributed to poor removal of anti-fogging compound.

"Thoughts of oxygen trouble began to penetrate because of the oxygen gage and physical symptoms in addition to the fact that the air began to have a somewhat stale odor. My physical symptoms began to get worse very rapidly and I decided that I felt too badly to continue the flight. At this time I was still somewhat aware of the fact that I might be having oxygen difficulties, but *my decision to abort was based entirely on feeling lousy.* I opened the face plate, extended the speed brakes and commenced a rapid descent. My physical condition began to improve immediately. . . ."

### Rebreathes Suit Air

Investigation showed that the composite disconnect for the full pressure suit had become partially disconnected in flight. The pilot had failed to tighten his full pressure suit face seal adequately. This had resulted in his rebreathing suit air.

For a recommended procedure for oxygen system preflight check on all full pressure suit flights see page 8.

### Oxygen Partial Pressure

Oxygen enters the blood stream because it is forced there by oxygen partial pressure. On the

# High Altitude—1918

**By Capt. R. W. Schroeder, Air Service, U. S. Army**



In order to take an aeroplane to a higher altitude than any other pilot in the world, I found that it would require more than one or two attempts. I made three attempts. The first one took me to 24,000 feet, the second to 27,000 feet, and the last one to 28,900 feet, but now I feel certain that I can get to at least 30,000 feet.

The cold thin air is one's greatest adversary. First of all, one must make a study of the performance of his motor at those altitudes. This I did, and made the necessary changes before trying again. Loss of power, due to rich carburetion, thin air, and the cooling of the motor, are the main things to overcome. Rich carburetion can be partially overcome by increasing the volume of air going through the carburetor, either by a mechanical process, air bottles, or other induced pressure system.

I believe, however, that high-compression pistons can be fitted very satisfactorily. This, of course, necessitates a throttled motor at low altitudes. An aneriod adjustment could be fitted to prevent the throttle from being opened wide at low altitude.

I used a set of high-compression pistons and paid keen attention to my throttle, which, however, I was unable to open wide, even at my highest altitude, for I noticed that when I did the motor lost RPM. This was due, I think, to rich carburetion. I maintained my RPM partially by feeding oxygen into my carburetor. A very efficient set of radiator shutters are needed to maintain the proper motor heat, these I did not have.

A very positive oxygen regulator and face mask should be used. These were unobtainable, for the sets I had previously tried out had failed to function above 21,000 feet. Furthermore, the face mask pressed so tight to my face that it interfered with the flow of blood and my face grew numb. So I used a rubber hose direct from the oxygen bottle, which I regulated with a valve on the bottle. The hose was placed in my mouth so that I could breathe air and oxygen at the same time. I also pressed my tongue against the end of the hose in order to tell if the oxygen was still flowing. This method worked very satisfactorily, except that the oxygen bottle and the rubber tube gathered about a quarter of an inch of frost, which made it very unpleasant.

The following experiences and sensations I noticed during my flight were due mostly to lack of oxygen:

I took off at 1:45 p.m., Wednesday, September 18, 1918, and made a steady circular climb, passing through clouds at 8000 feet, 12,000 feet and 16,000 feet. At 20,000 feet, while still climbing in large circles, my goggles became frosted, making it very difficult for me to watch my instruments.

When I reached 25,000 feet I noticed the sun growing very dim, I could hardly hear my motor run, and I felt very hungry. The trend of my thoughts was that it must be getting late, that evening must be coming on; but I was still climbing, so thought I might as well stick to it a little longer, for I knew I could reach my ceiling pretty soon, then I should go down, and even though it were dark I could land all right, for I had made

ground, the partial pressure of oxygen is sufficient to accomplish this. At altitude, however, the air is less dense and pressure is not sufficient to force enough oxygen into the blood stream to sustain human consciousness and life. The result is hypoxia.

Anything which interferes with the blood's ability to absorb oxygen or to carry it can contribute to hypoxia. (Among these factors are anemia, carbon monoxide poisoning and drugs and chemicals which interfere with oxygen absorption.)

A great danger of hypoxia is that it is impossible to predict exactly when or where hypoxia will occur in flight or how it will manifest itself. The symptoms are unique with each individual and will vary within the individual from time to time. Generally, the onset of hypoxia is characterized by sensations of sleepiness, fatigue, headache, blurred vision, confused mental judgement and loss of muscular control. Sometimes hypoxia will cause dizziness or nausea, giddiness or a feeling of extreme well-being. It can induce all the moods of intoxication. Physically, the skin and fingernail beds take on a bluish tint and the pulse and respiration will increase.[1]

### No Built-In Alarm System

Unfortunately, the human body has no "built-in alarm system" for the detection of hypoxia. For this reason, physiological training and refresher training in the low pressure chamber is important in order to familiarize personnel with subjective symptoms of hypoxia.

The symptoms and adverse effects of hypoxia result from its highly selective and fairly rapid action upon the most differentiated tissue of the body—the highest brain centers controlling conscious thought, judgment, discrimination, special sense organs and muscular activity. For this rea-

[1] NAA Service News, Columbus Division, Vol. IV, No. 12.

night landings many times before, and so I went on talking to myself, and this I felt was a good sign to begin taking oxygen, and I did.

I was then over 25,000 feet and as soon as I started to inhale the oxygen the sun grew bright again, my motor began to exhaust so loud that it seemed something must be wrong with it. I was no longer hungry and the day seemed to be a most beautiful one. I felt like singing with sheer joy as I gazed about through a small portion of my goggles which had no frost, due to a drop of oil which had splashed on them from the motor.

It was wonderful to see the very clear blue sky with the clouds thousands of feet below. The frost on my goggles bothered me very much. At times I had to remove my gloves in order to put the warm palm of my hand on the glass to thaw the frost. I did this about every 10 minutes, so that I could take the proper readings of the instruments, which I marked down on my data pad. I believe that if my goggles had been better ventilated they would not have frosted. When I was about 27,000 feet I had to remove my goggles, as I was unable to keep a steady climb. My hands by this time were numb, and worried me considerably. The cold raw air made my eyes water, and I was compelled to fly with my head well down inside the cockpit.

I kept at it until my oxygen gave out, and at that point I noticed my aneroid indicated nearly 29,000. The thermometer showed 32° below zero C. and the RPM had dropped from 1600 to 1560. This is considered very good. But the lack of oxygen was affecting me, I was beginning to get cross and I could not understand why I was only 29,000 feet after climbing for so long a time. I remember that the horizon seemed to be very much out of place, but I felt that I was flying correctly and that I was right and the horizon was wrong.

About this time the motor quit. I was out of gasoline, so I descended in a large spiral. When I had descended to about 20,000 feet I began to feel much better and realized that the lack of oxygen had affected me. I passed down through the clouds at 16,000, and as I remember it was snowing from these clouds upon the next layer some 4000 feet below. I am not positive of this, as I may have been affected by the lack of oxygen. I noticed as I descended that the air seemed to be very thick and stuffy, but very nice and warm.

I did not see the ground from the time I went up through the clouds above Dayton, Ohio, until I came down through them again at 4000 feet above Canton, Ohio, over 200 miles from where I started. I was lost beyond a doubt, with a dead engine over very rough country. I landed O.K., and broke the tip of my propeller, which was standing vertical, when I rolled into a depression on the ground. However, I did not nose over or do any other damage to the plane or myself. I flew back to Dayton with a new propeller.

My lips and four of my fingers were frozen and required medical attention. Electrically heated clothing would have been very well used, but I dressed as light as possible to avoid the extra weight, as I had stripped the entire plane of all unnecessary load. This was done to assist me in climbing.

If this record can be made official, it will be the first world's aviation record held by America since August, 1911. At that time the late Lincoln Beachey made a climb to 11,000 and some odd feet at Chicago, Ill.

son, the response of any individual to hypoxia is completely unpredictable but always serious, especially so when the subject is an active crewmember who contributes to the control of the aircraft.[2]

### Age Factor

The advisability of strict adherence to oxygen requirements on all flights was brought out in the case of a 45-year-old pilot of an R4D earlier this year.

The pilot experienced a heart attack while flying without oxygen at 11,000 feet. Thinking he had hypoxia, he relinquished the controls to one of the two copilots and went on 100% oxygen. He refused the suggestion that the flight return to base. Two hours later, his crew alarmed at his condition, informed him they were landing and radioed ahead for medical personnel to meet the plane. The pilot was transferred to a hospital where his illness was diagnosed as a myocardial infarction.

### Emotional Factor

The pilot had the day before received news of his father's death. It will never be determined whether the heart attack was precipitated by emotional stress alone or by hypoxia imposed on already diseased coronary arteries and emotional stress. However, the reporting flight surgeon felt hypoxia was implicated strongly enough "to warrant the restressing of oxygen requirements . . . particularly in older age groups . . . and particularly in transport squadrons where oxygen usage is not so closely scrutinized as in the tactical and high performance squadrons."

Obviously, this case could very well have resulted in the death of the pilot and strike damage to an aircraft had he been flying alone.

### Borderline Hypoxia Dangerous

Borderline hypoxia can be an insidious danger, especially on night flights. The following is the case of a pilot who violated OpNavInst 3710.7A which requires oxygen at altitudes above 5000 feet at night. At the end of the two-plane, seven-hour service hop to the carrier and back, the pilot made a wheels-up landing.

The flight out went as briefed. Although he had partied late the night before, the LT had had seven hours' sleep and two breakfasts; he did not feel tired. His only distraction was a malfunctioning heater control which had to be adjusted every 5 to 10 minutes throughout the flight.

On the return leg the LT flew wing. As the two ADs came in over the coast at sunset, they ascended to 10,500 feet. The pilot used his oxygen mask infrequently because he was smoking. He estimates that he smoked 8 to 10 cigarets on the flight, most of them during the return leg. For the 90 minutes of night-time flight at 10,500 feet, he used his oxygen only intermittently and not at all after the descent for landing at his home field. Denial of the flight's request for a straight-in approach to the break position irritated the LT considerably.



[2] Barron, "Human Physiological and Performance Limitations in High Altitude Flight," AF-A/C Industry Conference on Pressurization and $O_2$ Systems, 1958.

## Symptoms of Hypoxia

Dr. Charles Barron, medical director of the California Division of Lockheed Aircraft Corp., has described the symptoms of hypoxia as follows:

1. 0-5000 feet—ideal: asymptomatic
2. 5000-8000 feet—no symptoms in resting, healthy person except for (impaired) night vision
3. 8000-10,000 feet—long flights: fatigue, insomnia, weakness, irritability (transport aircraft)
4. 10,000-15,000 feet—progressive cerebral deterioration, frequently with insidious onset; headaches; visual changes; defective judgement; poor discrimination; slowing of reaction time; exhilaration
   a. Insidious onset with decrement in cerebral function
   b. Rarely unconscious
5. 15,000-22,000 feet—extension of above, with weakness, cyanosis (bluish discoloration of nail beds); tremors of hands, fingers and head; loss of useful consciousness (10-20 minutes) and death (1-4 hours)
6. 22,000-25,000 feet—loss of useful consciousness in 4-7 minutes
7. 25,000-30,000 feet—loss of useful consciousness in 1-4 minutes (death in 8-10 minutes)
8. 30,000-40,000 feet—loss of useful consciousness in 30-60 seconds and death in 2-5 minutes
9. 40,000-50,000 feet—loss of useful consciousness 15 seconds
10. Above 50,000 feet—loss of useful consciousness 10-15 seconds—death will not usually occur in less than 90 seconds, below 65,000 feet
11. At 100,000 feet—death in a few seconds from hypoxia and tissue fluid vaporization

### Makes Usual Approach

The LT made his usual approach without difficulty but momentarily lost sight of the lead aircraft after breaking. He was looking for him at about the time he would normally have lowered his gear. He did not use his landing check-off list.

After breaking, reducing throttle and lowering flaps, he reported to the tower including the statement, "gear down and locked." After acknowledgement and clearance from the tower he proceeded with this final approach. Later, he stated that he did not notice the red cockpit warning light indicating an unsafe landing gear condition.

Unable to change visors in flight, the LT kept his tinted visor up because it restricted his vision in the night landing. He opened his cockpit at the 45-degree position instead of the 180 because he wanted to keep debris from blowing up in his face.

The aircraft touched down at 90 knots with wheels up in a burst of sparks, smoke and fire. The LT was uninjured. The aircraft was a strike.

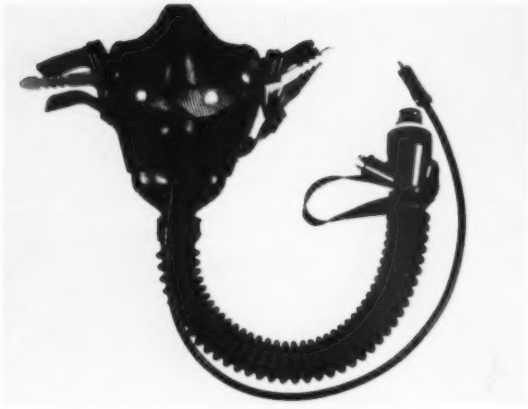
### Smoking Speeded Hypoxia

Commenting on this accident, the reporting flight surgeon states, "Although the duration of time without oxygen at 10,500 feet was not critical in producing symptoms of acute hypoxia, the added factor of carbon monoxide intake from the cigarets with its affinity for oxygen carrying hemoglobin was most probably enough to produce a borderline degree of hypoxia significant as a factor in producing fatigue." The borderline hypoxia aggravated by increased carbon monoxide content in the blood from smoking reduced the pilot's night vision.

### Defenses Against Hypoxia

As an airman, your best defenses against hypoxia are:

- Proper use of oxygen equipment and thorough knowledge of how it works. *Do not use a mask that leaks.*
- Scrupulous cleanliness of the oxygen mask. It is recommended that masks be cleaned every 30 days, but when a mask is in constant everyday use, it should be cleaned as often as required by the service condition.
- Thorough preflight of the oxygen mask prior to each flight. This should include at least a check of the general condition of the mask and mask connection, and a check to see that both inhalation and exhalation valves are properly seated and hose connections are adequate. You should make sure you can inhale and exhale through the mask *prior* to manning your aircraft.
- Thorough preflight of the aircraft oxygen system.
- Comprehensive physiological training covering the symptoms and effects of hypoxia. As required by BACSEB 7-54, squadron commanding officers "shall insure that proficiency in the use of oxygen equipment is maintained by all flight personnel flying or likely to fly to oxygen altitudes and shall require all pilots and aircrewmen to attend frequent formal and informal presentations covering the operation, maintenance and use of aviator's breathing oxygen equipment by the squadron safety equipment officer and flight surgeon."
- Strict adherence to the requirements for oxygen usage as stated by OpNav Instruction 3710.7A.

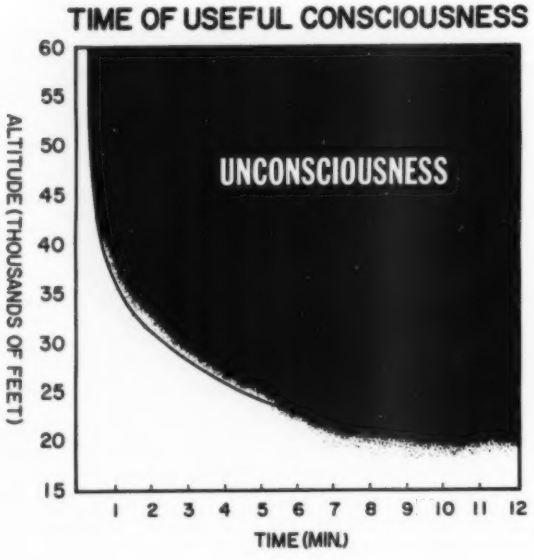


**The following material is taken from a paper titled "100 Years of Hypoxia" presented at the 1962 meeting of the Aerospace Medical Association by LT Edmund P. Jacobs, MC, head of the aeromedical branch of the Service Test Division, Naval Air Test Center, Patuxent River.**

The following design and procedure changes should help to alleviate some of the inherent hazards of the oxygen systems and could prevent recurrence of the types of accidents seen in the cases reported. In addition, many of the changes would facilitate physiological training and increase the efficiency of airmen, plane captains, and flightline crewmen.

1. Design oxygen-communications quick-disconnects to prevent inadvertent disconnection during flight.
2. In seats equipped with more than one oxygen connection, provide a distinctly different coupling for each oxygen line connection to prevent improper routing and attachment.
3. Use no more than two types of oxygen-communications quick-disconnects in all aircraft; one type for pressure suits and one type for all other oxygen equipment.
4. Use of the following preflight check for all oxygen mask-miniature oxygen regulator combinations:
   a. Attach mask and communications to aircraft.
   b. Point mask away from your person.
   c. Turn on oxygen.
   d. Listen for flow.
   e. Don mask and adjust to stop all leaks.
   f. Turn off oxygen and check for leaks.
   g. Turn on oxygen.
5. Use of the following preflight check for all full pressure suit flights:
   a. Lower helmet visor.
   b. Turn on oxygen.
   c. Tighten face seal until there is no leakage.
   d. Turn off oxygen at console.
   e. Breathe until oxygen is exhausted. Check for inboard leakage at face seal. Tighten face seal if leak is noted.
   f. Turn on oxygen.






Further decrease in hypoxia-caused accidents can be accomplished only by the development of an improved warning device. It is obvious that any oxygen system warning device located between the oxygen supply and the airman's mask cannot be depended upon to detect the failures that may occur between the device and the mask. It would appear, therefore, that the surest method of warning the airman of early or impending hypoxia would be the instrumentation of the airman rather than of the oxygen system. Such instrumentation should be designed to activate a warning device before the airman had become hypoxic or hypocapnic (a state in which there is a deficiency of carbon dioxide in the blood).

The most likely instrumentation for this purpose would be an oximeter or a device to measure partial pressures of oxygen or carbon dioxide. Oximeters as presently designed would be unsatisfactory because of pilot discomfort caused by contact pressure and heat. Partial pressure measuring devices have potential value as simple warning devices. However, there are some difficulties, both physiological and electro-mechanical which have to be overcome before they become practical. Refinements of these devices, or development of some new measuring concept is vital to development of an effective detection device.

# HYPOXIA PREVENTION Rx

The following BACSEBS are currently applicable to oxygen masks and regulators:

| | | |
|---|---|---|
| 7-54 | OXYGEN EQUIP; aviators, breathing-preflight and flight procedures | 7/25/51 |
| 27-54 | OXYGEN FACE MASKS; cleaning instructions for... | 6/1/50 |
| 42-54 | OXYGEN SYSTEMS; diluter-demand—general information | Undated |
| 50-54 | OXYGEN MASK; A13A inhalation check valve—modification of | 11/1/54 |
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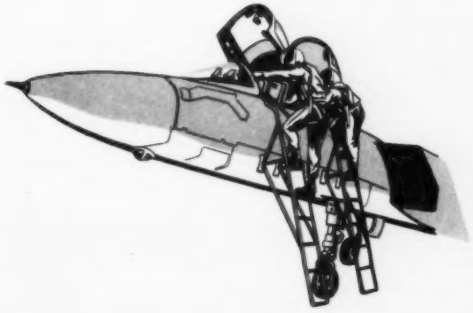

**Our product is Safety, our process is education, and our profit is measured in the preservation of lives and equipment and increased combat readiness.**

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**APPROACH** The Naval Aviation Safety Review Published by U. S. Naval Aviation Safety Center
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# LETTERS TO THE EDITOR

## Sees Eye To Eye

*New York*—Congratulations on the excellent round-up of information on vision in the February 1962 issue of APPROACH. It is the best I've seen.

Incidentally, "Applied Experimental Psychology" by Alphonse Chaponis has some pertinent information too.

JEROME LEDERER
Flight Safety Foundation, Inc.

## BACSEB Checklist

*Beaufort, S.C.*—Is there any checklist for BACSEBs? BACSEBs do not come out in consecutive numerical order and I have no way of knowing if my file is complete.

ANYMOUSE

**● The Publications Listing of Safety, Emergency and Survival Equipment prepared and distributed by the Naval Aviation Safety Center contains a list of BACSEBs which is revised annually. Between revisions, this list can be kept current by the addition of the supplemental pages issued with the Personal/Survival/Equipment Crossfeed.**

**BACSEBs are also listed in NavSandA publication 2002, formerly NavWeps 00-500.**

## Photo Posting

*Otis AFB, Mass.*—Your excellent magazine is well received by our squadron pilots. Our unit, the 960th Airborne Early Warning and Control Squadron, flying RC-121D Super Constellations (WV-2 Barrier Aircraft), holds the top flying safety record in the Air Defense Command by remaining accident-free for eighty-three (83) months. This covers the entire period since the start of AEW&Con operations at Otis AFB.

We use your idea of humorous captions by posting thought-provoking pictures from APPROACH and inviting crewmember comments.

ORRIS S. MERRILL
Major, USAF
Commander

**● Congratulations on your excellent safety record.**

**Mention will be made of your adaptation of the "You Write The Caption" idea in our forthcoming ASO Reference Manual, successor to the ASO Guide.**

## Background Boards

*Midway Island*—Pilots were having difficulty picking out the taxi director from the blending background of trees, bushes and small utility buildings. We feel that we have found the answer to this potential accident situation by:

(1) stationing the director in the same spot for each aircraft; and,

(2) building a white background board which is in direct contrast to the natural background, and which clearly outlines the director and his signals.

We have had such favorable comments from the pilots concerning the use of these boards that we would like to pass this idea on to anyone else who is having complaints about their directors and/or director's signals being lost in the surrounding background. The photographs illustrate our ideas on the size of the boards as compared to the height of an average man. The boards are effective for day or night use.

H. H. ELLIOTT, LCDR
Aviation Safety Officer

**APPROACH welcomes letters from its readers. All letters should be signed though names will be withheld on request. Address: APPROACH Editor, U. S. Naval Aviation Safety Center, NAS Norfolk, Va. Views expressed are those of the writers and do not imply endorsement by the U. S. Naval Aviation Safety Center.**

## Black Shoe Suggestion

*San Diego*—I don't know if you are permitted to give any consideration to recommendations submitted by *Black Shoe* Navy personnel; however, I have an *Airedale* brother whose safety is a matter of concern to me. Therefore, I am writing you.

In the Dec. '61 APPROACH (which I sneak a peek at when nobody is looking) there is a write-up under Murphy's Law about a possible fatal error in the connection of the slide-disconnect cable of the Martin Baker Ejection Unit and the main parachute ripcord attached to the slide disconnect. Obviously, as an administrative type LDO, this is completely out of my realm.

However, as I understand the problem, the error is the result of two cables of similar appearance assigned to perform definitely dissimilar functions and the only way to determine which is which is to ascertain which of the two is 1¾" longer than the other. Clearly, there should be no problem since even a person with only a limited education should be able to make such a determination—but as clearly, as shown by T. B. Wood, CO, VMAT-1, *someone* was unable to do so. Or at least, once he had determined which was the longer, he forgot where to properly attach it.

My recommendation—for what it's worth—is that someone should institute a move to have color applied to mutual connections when setting up the Martin Baker Ejection Unit. Thus, when airman apprentice Jones holds two separate cables in his hands, instead of saying, "Which is longer and where does it go?", he merely recites "Red to red and green to green and another successful ejection is seen!" Of course, this theory discounts the fact that Jones might be color blind, in which case, just forget I ever mentioned it!

Thank you for your indulgence. Yours for many happy—and successful—ejections.

PAUL B. KINCADE, LT
ComPhibPac Staff

**● Your suggestion to color code the slide disconnect cables of the Martin Baker Ejection Unit has merit. However, unless color coding is part of the manufacturing process itself, it is not completely satisfactory. Permanently coloring metal is an expensive and involved operation.**

**Perhaps the answer to the problem in question lies in redesign of the cables so that it will be impossible to install them incorrectly.**

**Your interest is greatly appreciated. A copy of your letter will be forwarded to the Bureau of Naval Weapons division concerned with ejection seat maintenance problems.**

## *Air Refueling Lighting*

*Atlantic Fleet*—Increased emphasis on all-weather flying by carrier aircraft squadrons has established expeditious and assured aerial refueling as an operational necessity.

Attack Squadron 34 has, therefore, designed a lighting system for the paradrogue to eliminate the problems encountered at night by receiving aircraft. The lighting system is being used on a test basis and more than 200 plug-ins have been made by F3H, F8U, and A4D aircraft at night without a discrepancy.

A prototype contributed to saving an F3H while on a divert heading in a low state condition with marginal weather at the divert field. The pilot was on his first deployed night flight after reporting from RCVG training and was not qualified in night refueling. His plug-in was accomplished on the first attempt.

Designers of this lighting system are LTJG R. C. Allen and Chief Aviation Electrician B. B. Hassler.

G. BOICE
CAG Three

LT A. Courtney Yelle Demonstrates the patrol Squadron THIRTY "Box Lunch Instrument Hood"

## *Box Lunch is Training Hood*

*Jacksonville*—The standard Navy box lunch provided as a flight ration for aircrews has always occupied a controversial position in aviation circles. Scorned by same, eagerly devoured by others, and debated heatedly by all, the box lunch has taken on new lustre and possibly fame as a valuable training device.

LT "A" Courtney Yelle, an instructor pilot with VP-30, has solved the problem of simulating instrument flight conditions by devising a practical instrument hood using the top of the standard box lunch. The "box lunch hood" is made by removing the top from a standard box lunch and cutting a one-inch "V" shaped notch in the tab side. The notch is fitted under the visor button on either the APH-5 or the DH-51 helmet and by creasing the sides as necessary the hood will conform to any aircraft cockpit configuration. In addition to its simplicity it can be removed quickly if an emergency arises.

The instrument hood is used by the PROs of VP-30 in training replacement pilots in instrument flying techniques in the P2V and the P5M. The Jacksonville patrol squadron is the Atlantic Fleet anti-submarine warfare replacement training squadron whose graduates go on for duty with Atlantic Fleet Patrol Squadrons.

VP–30

● **Comment overheard: "Best use yet for box after throwing away contents of some."**

"All right! Which joker filed via the Southern Pacific Railroad?"

## *You Can File Via SPRR*

*Andrews AFB, Md.*,—In reference to your cartoon on page 23 of the Feb '62 APPROACH.

He may be right! That intrepid birdman who filed via the Southern Pacific Railway may have been heading for Holloman Air Force Base, New Mexico. If you'll check the Holloman listing in a current FLIP Enroute-Supplement note the instructions to that effect under the remarks.

It looks as if the Iron Compass is still an effective navigational aid.

ROGER D. OVERSTREET
CAPT USAF

● **The following is from a FLIP enroute-supplement:**

AERODROME/FACILITY DIRECTORY 83

**Hollomon AFB**, N. Mex. (Alamogordo( 32°51'N 106°06'W
SW, **M-3**, L-4
AF 4094 BL6, 7 H121 (ASP) S3 (S100, T155, TT380)
**JASU**—1(C-21), 6(C-26), (MD-3), (MA-1A), 4(MC-1) **FUEL**-A+AJ MIL-L-7808 AVOIL

**J-BAR**—Rwys 15-33, 21R, 25 LHOx Lq-Ox

**Remarks**—Fol VFR procedure in effect: fr El Paso via Southern Pacific Railroad to HMM not above 8000′ MSL. etc.

## *Record Challenged*

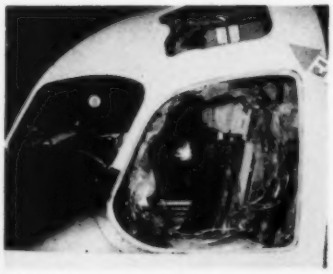
*Atlantic Fleet*—LT Seaman's letter "Stoof 'Scape," invites challenges of LT Kentopp's record of 50 seconds, claimed by VS-23, in escaping from an S2F by exiting through the side window.

LTJG S. F. Walker of VS-22 while embarked aboard the USS LAKE CHAMPLAIN on 6 Aug 1961, exited in the manner described by LT Seaman with two exceptions:

First, the tip of LTJG Walker's survival knife broke during the operation. With the clock still ticking, LTJG Walker obtained the hatchet from the bulkhead behind the copilot's seat and completed the job.

The second exception was the time involved. Forty-three seconds after LT J. L. Archambault (photo) signaled "go," LTJG Walker was completely out of the airplane. Any other challengers?

D. J. FLORKO
LT, VS-22



● **Puh'lease use surveyed windows ! !**

## *Bungee for Belts*

*MCAF Santa Ana. Calif.*—March issue, p. 21, a pilot complains of seat belts caught in the collective of an HUS-1 causing an overspeed.

HMR 261 solved this problem with two pieces of $\frac{3}{16}$″ bungee approximately 16″ long.

This was accomplished by putting a $\frac{1}{2}$″ loop in each end of the bungee, passing one end of it through the hardware slot on the stiffened portion of the seat belt, passing the other end through the previous formed loop, making a type of a noose about the seat belt, securing the free end of the bungee to the seat back in the 1st hole that is drilled there already with a small bolt and nut and two washers to place the bungee between.

This procedure complies with all the existing directives on the modification of aircraft.

The idea of using two pieces of bungee as retaining straps is good and we used this for a while but they only lasted for a couple of months due to the constant flexing of the bungee. The method that I have explained lasted in excess of a year and a half. It will hold the stiffened part of the seat belt at a 45-degree angle and will travel up and down with the seat as it is raised and lowered. It will actually assist in entering and exiting the aircraft in that it pulls the belt away from the pilot when the belt buckle is loosened.

I hope that this helps.

ARCHER D. HURD WO
MACS-3 AirFMFPac

● **Good dope, thanks!**

## NATOPS Instruction Revisions

**While the April issue article on NATOPS (page 13) was being printed, so was a new OpNav Instruction on the Naval Air Training and Operating Procedures Standardization program. It is OpNav Inst. 3510.9A of 26 Mar 1962.**

**This instruction makes a number of important changes to the basic program, which will be reviewed in a later article. Readers should check the instruction in the meantime.**

**We also reported that type commanders designated squadron Standardization Instructors. This is wrong—the squadron skipper does! On the same page (must have been a bad day somewhere) we managed to list Op-561 as Op-461, and to imply that general suggestions on the NATOPS program should be sent direct to the Pentagon. These should go through appropriate channels.**

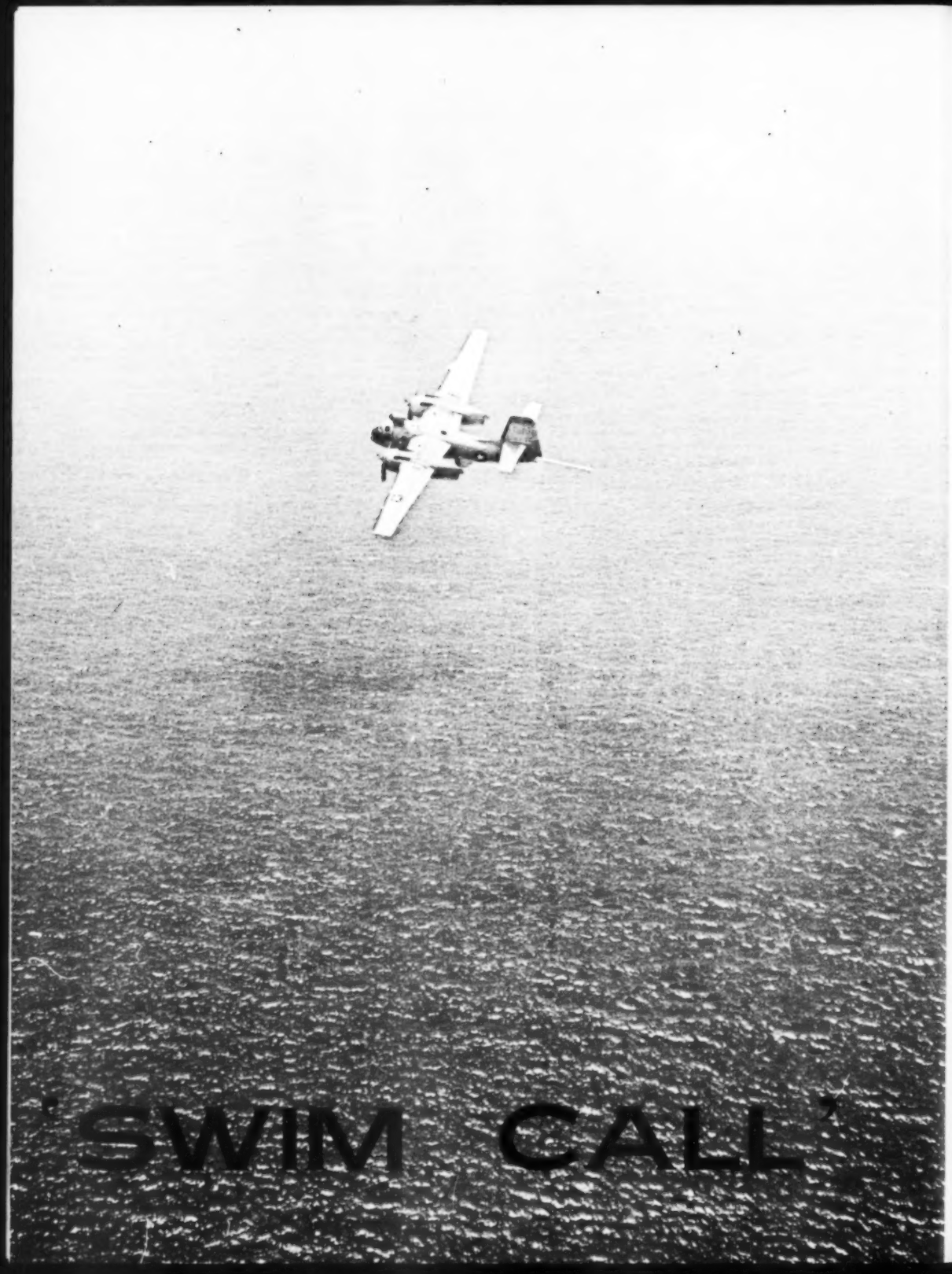
## *Old Crusaders Never Die*

*Dallas, Texas*—Just got back from a week on the ENTERPRISE observing some catapults and landings.

Thought maybe you could use this picture of an F8U. The old dog is one they put aboard to give the crew some practice in towing and positioning on the cats. It sure was raunchy looking and it hurt me every time I saw it.

ART SCHOENI
Ling-Temco-Vought, Inc.

**U.S.S. ENTERPRISE utilizes aircraft damaged beyond repair for shakedown flight and hangar deck handling practice.**


'SWIM CALL'

## Follow this crew through their ditching experience

On the last leg of a routine ASW flight, a loud explosion from the port engine was heard by the four crew members of the S2F. The pilot's plexiglas window was shattered and the aircraft swerved to the left. Climbing and executing single engine procedures, the pilot determined that the port propeller assembly was missing entirely and there was extensive damage to the surrounding cowling and nacelle. The port tank fuel level dropped almost immediately from 700 pounds to 150 pounds. They decided that a landing was feasible but all were aware that fuel state versus fuel consumption might prevent their reaching the ship.

Approaching the carrier, the pilot lowered the landing gear. As they began a turn, the starboard engine failed. The pilot leveled the wings, the engine caught again and he declared his intention to ditch. The starboard engine continued to run intermittently until 500 feet when it quit for good.

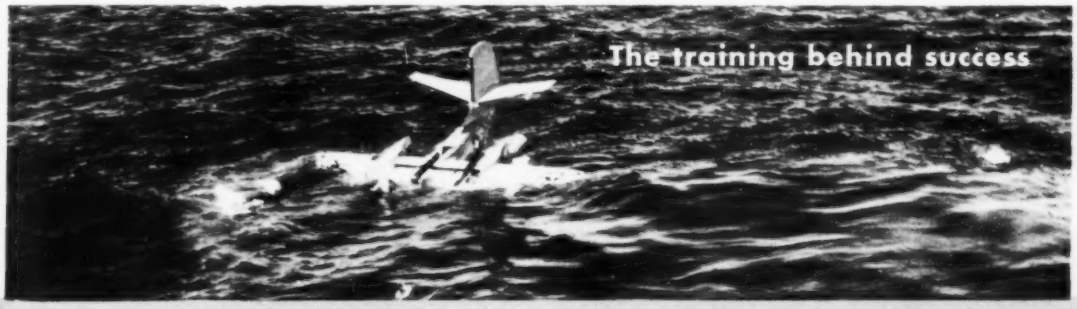
The pilot ditched the aircraft about six miles astern of the carrier. The final portion of his glide was made with full flaps, starboard engine windmilling and gear in the up or trail position. The plane contacted the water at 78 to 80 knots.

"The engine was sputtering now and the pilot put the nose down and told us to stand by to jettison our hatches, that we were going to have to ditch. I think that we were at about 1600 feet at this time. It seemed like only seconds later that he gave the order to jettison our hatches and to stand by. It was the weirdest feeling—no sound at all except for my heart beat . . ."—*ATN3 Radar Operator*

"There was a tremendous crash and the impact was much harder than I had expected. I had the impression that the side window had shattered completely. The cockpit very rapidly filled with water to the instrument panel. By the time I had released my harness, water was up to my chin. I had no trouble getting out of the hatch and clear of the aircraft."—*Pilot*

"It seemed like a second, then we hit the water. There was no skip or bounce; we hit just once. It felt as if the whole plane was crushing in on me. As soon as we hit it seemed as though water was up to my head. The MAD console hit me in the chest . . . I pulled my harness release and squeezed by the console. By this time water was gushing in through the overhead hatch and hitting me in the face. I fought my way out and swam






### Statement of pilot LT Hayes, VS-39

So far as training my own crew is concerned, I have no "special" program. Most of the emergency procedure training is conducted in accordance with squadron doctrine. One item I like to include frequently (and will do regularly from now on) is a self-induced simulated single engine at low altitude in the ASW search configuration and without prior notification to the crew. There is no problem of controlling the aircraft since I have things set up in advance in the cockpit. It gives the crewman an opportunity to recognize the characteristics of a power loss, without being told what is happening, and immediately apply his emergency procedures of retracting both mad boom and radome.

Other drills conducted are engine fire, fumes in the cockpit, electrical fire and ditching procedure. Crew coordination and voice procedures are emphasized. When operating ashore we occasionally have a bailout drill after shut down to keep the crew aware of the problems in rapidly donning parachutes and clearing the aircraft properly. I have emphasized the need for this in the air by simulating a double engine failure and trimming for a glide. When the crew has called ready for bailout I inform them of the altitude, letting them know their chances for survival if they had to bail out at that height. Some of the crewmen I've flown with never did realize the importance of rapidly donning their chutes when confronted with a high rate of descent until they tried this drill. Except for the latter example all drills are standard squadron practice, in accordance with the safety/survival program.

The training I experienced prior to being designated a CAPC was similar to the above. Definite safety conscious flight procedures were emphasized especially

a couple of yards. . . ."—*Radar Operator*

"The breath was knocked out of me and my first thought was to get out. I hit the seat belt and without pulling my radio cords, I evacuated the cockpit. I retained my helmet. Outside, I saw one of the electronics operators to my right and helped him inflate his mae west. My mae west inflated correctly. We counted heads and climbed into the raft which had been inflated by the salt water actuator. The plane remained afloat with only the tail sticking out of the water for about a minute. It was like an illustration in APPROACH Magazine."—*Copilot*

"I escaped with comparative ease . . . An eerie steam was rising from the water as I swam past the starboard engine."—*MAD Crewman*

"Everyone seemed to have gotten out before I did and I called to see that they were all right. The life raft had inflated and I grabbed it until the others got there. We helped each other into the raft and began setting up the radar reflector and using our flares. We were like a bunch of kids on Christmas morning opening our gifts." —*Radar Operator*

Here is part of the pilot's account of the water survival phase of the accident:

"Once clear, I turned to look for the rest of the crew. The first thing I saw was the four-man raft inflating and the tail of the aircraft. Then I saw the MAD operator swimming towards the raft and to the left two more heads. I called to check for injuries. Everyone seemed to be okay so I told them to swim for the raft. I had not yet inflated my life vest and I was surprised at how easy it was to stay afloat and swim even with flight boots on.

"When I reached the raft I held on to the hand lines and inflated my mae west. Once everyone had arrived, I told them to swim away from the plane and tow the raft clear. We looked for the line that holds the raft to the plane in order to cut it but we could not find it. The line probably broke as the plane sank. All the mae wests inflated properly and no one had any difficulty swimming. The sea state was slight; the water was warm with a taste of gasoline.

"As we drifted away from the aircraft we climbed into the raft and checked again for possible injuries. The aircraft had settled in a left wing down, nose down attitude. The tail and starboard wing tip were visible when I last saw it. I checked my watch; it was about 0330. Once settled in the raft, I broke out the survival gear and gave the radar reflector to the copilot. He and the MAD operator began to set it up and I gave the extra flares to the other crewman. Then we



with regard to over-zealousness in "going a little lower and get that pin-banger" at the expense of a margin for error.

The publications I am most influenced by are APPROACH, "Naval Aviation News," and the "S2F Flight Manual." The articles in APPROACH were remembered most vividly during the emergency, to the point that I felt we were acting out a compilation of all the ditching articles I had read. After we were all settled in the raft and everyone had at least one specific task to keep him busy, I even tried to tell a few appropriate jokes because I had remembered reading this in some article. The entire procedure during the flight back towards the ship followed items I remember reading; testing slow flight characteristics at altitude after briefing for a bailout in case of loss of control, and dropping the hook to be able to advise the ship that we could land aboard. Once I knew we could fly an approach I briefed for a possible ditching, remembering stories of planes having to ditch close aboard after trying to land. When we ran out of fuel I rememberd to leave the engine windmilling to provide hydraulic and electrical power . . . again, a procedure I had previously read about.

Being able to do all this in the stress of events was due mostly to the attitude toward safety prevalent within the squadron. Personal interest in emergency procedures is accented and there is a wide dissemination of safety/survival information. This is a squadron effort as is emphasized by the fact that I had never flown with this particular crew before. In fact, no one of us was on the same regular crew. This is not the result of a flashy program with special gimmicks, but an every day "it's part of the job" attitude toward flight safety.

M. F. HAYES LT
VS-39

**Statement of Aviation Safety Officer LT Hogan**

Just as the accident involving LT Hayes' night ditching has generated considerable interest at the Safety Center, so has your comment concerning this squadron's apparently successful pilot/crew training program provoked us to some measure of introspection.

Our training program is oriented on a squadron basis. This is attested to by the fact that none of the four crewmembers involved in this accident was assigned to a common ASW tactical team. But in scrutinizing our lecture/drill program involving safety and survival procedures we find the emphasis is placed upon pre-planning various situations so that reactions become second nature when the situation presents itself. In LT Hayes' case that involved immediate application of low altitude single-engine procedures and associated emergency reports followed by the use of time available to consider the situation and cover with the whole crew the various measures that might have to be taken. That, in essence, is our goal: automatic reaction when necessary; when time is available, consider all possibilities and then apply that motto so aptly described on the safety poster, "The best safety device is between your ears."

To apply such an all inclusive flight safety theory we split the program into three major areas; i.e., *lectures, individual study* and *simulated drills* involving various emergency situations. Since safety always breaks down to an individual function, we attempt to (1) get the individual interested in a certain phase of aviation safety, (2) hoping he'll resort to personally referencing some of the available literature on the subject and (3) then go simulate it in the air.

Without gundecking I'm sure our lecture outlines don't come close to matching some of those of

rigged the oars, securing them to the oarlocks with lanyards which were already there.

"We turned on our life vest flashlights and when an aircraft made a searchlight run on us, the copilot ignited one of the night flares. The flares were hard to ignite because they were wet and slick and our hands were wet. While the copilot ignited the flares the rest of us waved and gave a thumbs up. The aircraft made a few runs with the searchlight and then circled our position. I noticed smoke in the water some distance away. I loaded my .38 with tracers and when the mast lights of a DD appeared, I began to fire straight up. When I had expended my load, the copilot began to fire his .38. Then we ignited another flare, and I aimed my flashlight towards the DD. As it approached closer, we blew our whistles in unison and lighted off one more flare. The copilot hailed the bridge a few times and we heard them reply that they had us in sight. We began to row toward the ship as it drifted down on us and soon were alongside.

"We were thrown a line and were pulled to a ladder over the side. The line was tied to the raft. I held the bottom of the ladder as the crew climbed aboard."

"The destroyer picked us up about a half an hour after ditching. The bridge watch stated that they heard whistles and shouts and saw our vest flashlights, flares and tracers. They picked up the radar reflector at about four miles. . . . Warm showers, clean clothes, hot food, coffee and hospitality were provided us as if SAR at night was a routine operation for the DD. . . ."—*Copilot*

The radar operator commented on the survival aspects of the accident:

"I think that the main factors in our surviving the ordeal were leadership, a fine pilot and copilot, prior lectures in ditching and bailing out and the facts that no one panicked and we had a time factor to our advantage to discuss what we were going to do. . . . I don't think I will ever forget the name of the plane guard destroyer or this night as long as I live. . . ."

The AAR and endorsements had this to say about the crew's actions:

"The proper execution of all emergency procedures and the successful night ditching are directly attributed to the professional performance of each member of the crew. . . . The exit from the plane, use of survival equipment and actions during the rescue were commendable. The survival training which each man had undergone was undoubtedly of value and helped each man to remain calm at a time when correct actions were of the essence. . . ." ●



other units in the fleet. However, I've seen outstanding lecture outlines and syllabi presented in such a manner that the whole audience is lost in a matter of minutes. So then it breaks down to being a case of salesmanship, the product being individual initiative in applying the topic personally. We find the "it can't happen to me" attitude is most effectively curtailed by frequent reference to the "Weekly Summary," "Safety Council Minutes," "S2F Accident Summary," . . . . Any method by which we can bring the message home is constantly being sought and applied.

Through frequent use of reference material and sales pitches for same, we stimulate individual consideration of these materials. Needless to say, APPROACH is our best source of info as it continually contains articles worthy of extra merit and particular application to our type flying. Briefs of type accidents/incidents/flight hazards/ground accidents are usually good for stimulating group discussion and the associated individual consideration.

The drill phase is conducted statically for bailout and ditching drill and inflight for various other emergency procedures such as single-engine flight, fire in flight, preditching procedures, etc. These emergency drills are tabulated on an individual and/or team basis as applicable. The emergency procedures are standardized so that team reorganization will not negate prior training.

The foregoing is a general outline of our pilot/crew training program.

a. This squadron requires each team to undergo a static bailout/ditching drill once a year on a formalized basis. Efforts are made to make this as realistic as possible. The dilbert dunker, parachute release drill, life raft familiarity and swimming tests are run annually at the station pool.

b. Safety lectures covering all phases of aviation safety are given monthly and cover such topics as emergency procedures, winter flying hazards, shipboard safety, ditching, aircraft accident investigation and reports. These are supplemented on a weekly basis by dissemination at an all pilots' meeting of pertinent information excerpted from the "Weekly Summary," "Crossfeed," accident briefs, APPROACH articles, "Safety Council Minutes," etc. This we find to be the heart of the training program in that the particular topic or situation is brought home through group discussion and individual consideration. Here is where preplanning has its inception and, as in LT Hayes' case, the presentation of a similar inflight emergency results in a culmination of all these earlier considerations. Thus the clutch factor is immeasurably reduced and the "lucky" pilot is the one who early assumes the professional approach to preplanning an emergency.

c. Listed above are the publications and information found to be most helpful in developing our aviation safety program. In particular, the article in the Aug. '60 APPROACH, entitled "Ditching Landplanes," has proven to be an outstanding survey of the entire ditching situation and is particularly applicable to our type flying.

As the foregoing indicates, our aviation safety program as relates to pilot crew training is more a matter of developing the professional approach individually than any other one thing. Should you desire any further information concerning our methods of attempting to attain this goal I will be most happy to furnish it.

L. M. HOGAN, LT
VS-39

# METRO

A pilot once said: "Facts can be gained from reading books, judgment comes from experience." This gent wasn't sneering at books and schools. He was pointing out that the end of formal training is not the end of the learning process.

This certainly applies to meteorology since not all the items which go to make up an advanced education in aviation weather are down in black and white—to put out a book covering every detail would be impractical—so the "experience getting" process sometimes depends on applying fundamentals to get the answer to a practical problem. With enough personal exposure (experience) a pilot may develop a "rule" (judgment) to use for a particular situation. The same thing can be said of the weatherman's path to judgment.

About the first rule that comes with developing judgment is that rules concerning the behavior of weather are not 100 percent effective—one time out of a hundred the exception will bring embarrassment or even tragedy. You need not look much further for the reason for suspicious pilots or pessimistic weathermen when dealing with such precise measurements as a 200-foot ceiling, ½-mile visibility, light icing, moderate turbulence, etc.

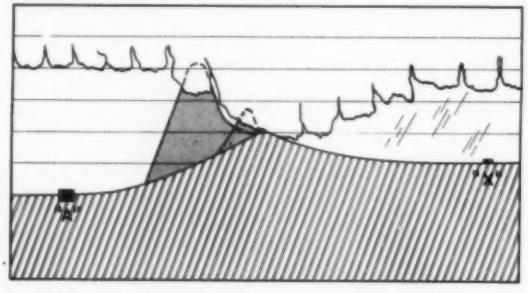
One rule-of-thumb concerns mountain flying: "Don't trust a pass to get you through a low ceiling area on a VFR flight plan." Be wary. Clouds formed on the windward side of mountains may block the exit (or entrance), even though ceiling reports on both sides of the mountain might suggest the pass will be clear.

The small chart is a reconstruction of actual weather faced by a pilot trying to go VFR through a mountain pass from "A" over to "X," about 30 miles away. He was alone in a prop aircraft and took off from "A" with a ceiling of 3500 feet, better than 15 miles visibility. At "X" the ceiling was 1500 feet and 15 miles visibility. The higher peaks were obscured, there were scattered rainshowers around "X" and the wind was upslope from "X" to "A." Strictly on the basis of the lowest reported ceiling there should have been a minimum ceiling of 700 feet at the highest elevation in the pass. The weatherman felt it would be better than that.

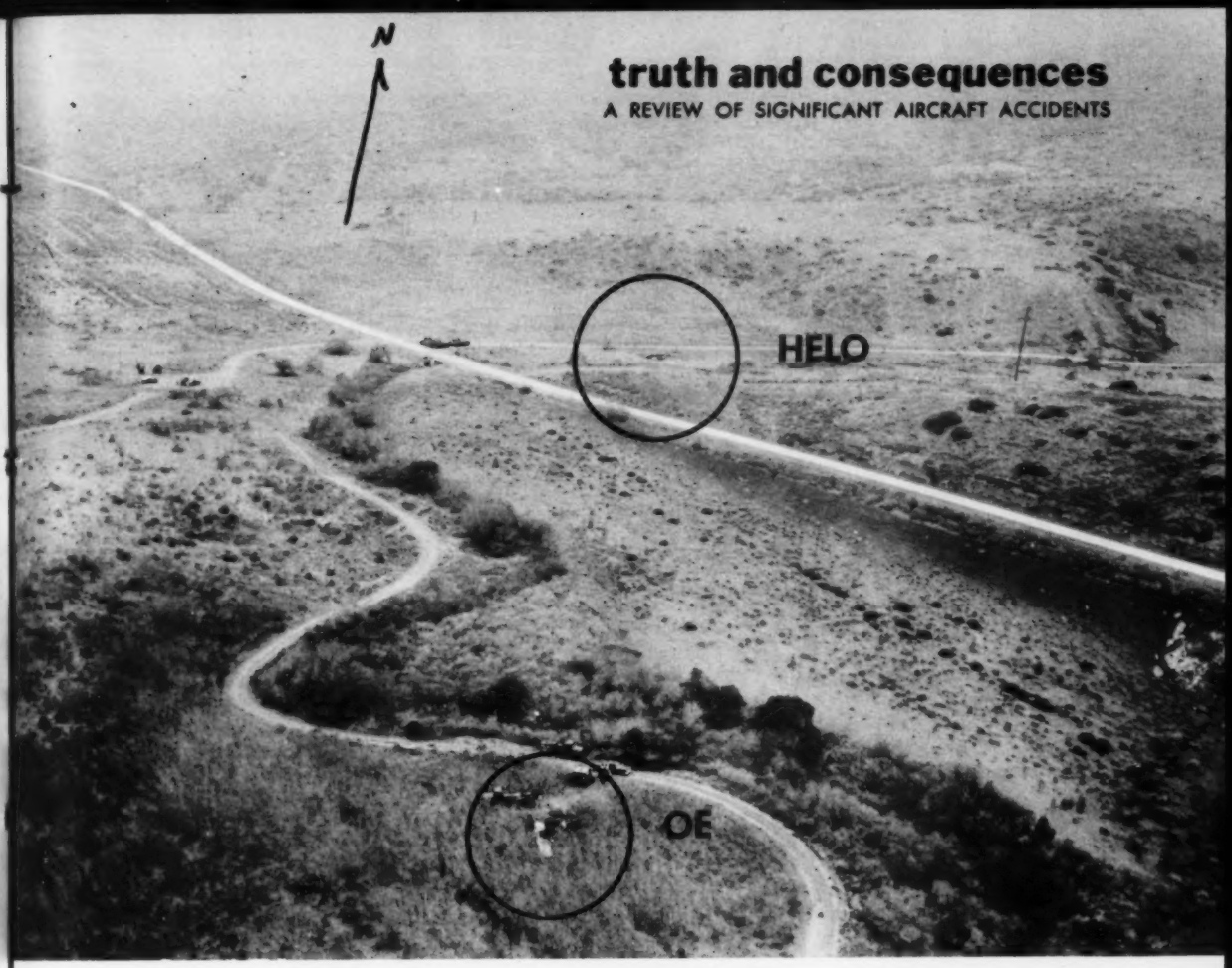
"Considering the estimated time of departure (midmorning)," he said, "I forecast gradual lifting of the ceilings in the pass to approximately 1000 feet due to heating. In previous conditions of this type, where there is rainshower activity instead of steady rain over the mountains, I have noted a gradual lifting of the clouds reported by the few stations to the east."

However, the ceiling in the pass lowered instead of lifting. In fact it slumped right down to zero-zero at the crest. The pilot followed a highway which led through the pass and by the time he was within three miles of the highest elevation he was squeezed down to less than 200 feet above the ground, just under the cloud base. Nevertheless he pushed on until the lack of ceiling and visibility at the fogged-in crest forced him to start a 180-degree turn back down the pass.

Mountain passes and valleys are useful—for example the Monterey crew take advantage of Pacheco Pass and Panoche Pass on occasion—but when marginal VFR weather in mountainous terrain begins deteriorating unexpectedly, don't wait too long before making the 180, especially if the terrain is relatively unfamiliar. That one in a hundred exception may be working against your forecast. ●




From "A" to "X" VFR?




# DOUBLE TROUBLE

FOLLOWING a midmorning briefing, a group of student aerial observers paired off with their assigned pilots and walked to the flight line. Both helicopters and fixed wing liaison planes were scheduled to fly the observers and since each team would fly individual missions the various aircraft launched at random intervals.

One of the OE-2 liaison planes was late getting airborne. The pilot had questioned the condition of a fuel tank vent and would not accept the aircraft until maintenance personnel corrected it. Such action sounds usual for a man described as a serious, conservative and thoroughly reliable pilot, with extensive experience in liaison operations.

Considering the independent nature of the work plus the special characteristics of the helicopters, it is probable that the pilot of the OE-2 gave them little thought as he got airborne and became involved in his own flight, yet in less than an hour his fate and that of his observer would be tragically bound to one of the helos disappearing in the distance ahead of him.

Weather for the mission presented no particular problem for the low flying aircraft. Visibility ranged from 10 to 2 miles in haze but that was not unusual for a summer day near the sea coast. The haze and a scattered layer at 1500 feet gave the impression of an overcast.

One helicopter proceeded down to the coastline and orbited a beach area while the observer noted types and numbers of

armored vehicles in the area. Then the helo turned inland and headed toward a known tank park in the foothills. All this time the observer was searching for concealed or camouflaged armor.

Following an inspection of the tank park the helo zig-zagged up the coastal area sniffing out targets between the beach and hills. After some 20 minutes the observer thought he spotted a target on the ground and asked the pilot to circle the spot.

"Soon after we went into this turn," the observer said, "I heard a loud explosion and we began to descend fairly rapidly. There was some shaking and swaying unlike normal practice autorotations. We hit, went slightly up on the nose then flipped over on our right side. The blades, still turning violently at this point, bit into the dirt.

"The cabin filled with dust from the prop action and there was a loud 'woosh' much like the sound made when a match is tossed into a gasoline soaked item. The whole area under the right side had burst into flame."



Although each of the aircraft carrying student observers was operating independently they were all covering the same general area and the OE-2 which was delayed in getting airborne happened to be in the immediate vicinity. The gush of black smoke from the crashed helo came with shocking suddenness.

By the time this OE-2 was over the wreckage, both the helo pilot and observer were coming out of the cockpit but the pilot's flight suit was burning on the shoulder and leg. The observer smothered the flames then helped the pilot clear of the area.

In his desire to aid the survivors the OE-2 pilot came in low and commenced circling in somewhat of a racetrack pattern. He transmitted a series of Maydays which were heard by another aircraft and then, apparently becoming upset by the sight below, he was heard to transmit "Get them out of there boy, get them out of there—you're on fire!" Witnesses indicate the altitude of the OE-2 to be about 400 feet or lower with the radius of turn rather short.

The helo observer went to a clear area, waved to the circling OE-2, gave an "OK" sign, then he turned his attention back to the injured helo pilot. There was no sense of isolation as people from nearby vehicles were converging on the area.

Except for another pilot in the vicinity overhearing transmissions from the OE-2 and acting as radio relay by climbing and proceeding toward the airfield, the knowledge of the crash could have been delayed since the OE-2 pilot continued to circle the crash at low altitude.

While completing a 180-degree turn to the left, the OE-2 stalled and flipped into an extreme nose-down spin to the right. Just prior to impact the rotation stopped but the aircraft fell vertically in a 45-degree nose-down attitude. It hit and burst into flames. The helo observer stared speechless and began to run toward the spot but there was nothing which could have helped.

Close examination and laboratory tests of the wreckage failed to reveal any malfunction of material and it was surmised that the pilot was concentrating so closely on the burning helo that he inadvertently pulled into a stall. Speed of the aircraft at the time of the initial stall was quite slow. Indications were that the pilot recognized the situation immediately and initiated corrective action. However, the low altitude evidently caused him to "rush" his stall recovery and thus he progressed into an accelerated stall/spin.

*If we had back half the pilots and crewmen lost in low altitude turns—especially downwind turns when pilots subconsciously interpret ground speed as airspeed—we could start another Air Force.*—HEADMOUSE

## Proper Procedure Pays

If you encounter jammed controls *on the ground* you should not force them free. Hold light pressure on the control until the trouble is located. BuAer Inst. 3750.7 covers this procedure and TraRon FIVE reports that it works!

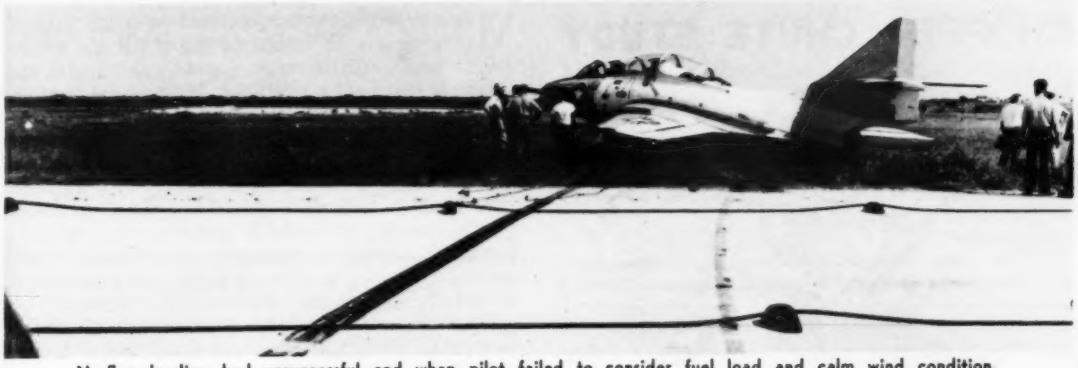
An S2F had been griped twice that the "ailerons seemed to stick." The third time it occurred (during controls free check) the pilot felt the ailerons "stick" and taxied back to the line. The trouble—a screw driver inside the wing panel had been floating around and was occasionally picked by the control cable.

Proper procedure (finally) located the trouble and a hazardous situation, to say the least, was eliminated. Of course, good maintenance procedures are best. Count tools after a job *before* signing that the work has been completed.

## Solo Flap

CONFRONTED with a no-flap landing on his first solo in the F9F-8T, a student contacted his instructor for assistance. The instructor was not in the vicinity of the pattern but attempted to advise his student on procedures: Shutdown on touchdown and try to clear the runway at the end turnoff.

With 2500 pounds of fuel on board the pilot allowed for an approach speed of 140 knots. After securing the engine he waited until 120 knots to commence aerodynamic braking which gave 5500 feet of runway remaining. Wheel braking was commenced just prior to crossing the arresting gear but no effort



No-flap landing had unsuccessful end when pilot failed to consider fuel load and calm wind condition.

had been made to drop the hook.

The aircraft angled to the right toward the turnoff but when the pilot saw he would be too fast to make the turn he blew the left tire with heavy braking in an attempt to straighten out and roll straight off the end of the runway. However, the jet still angled to the right and engaged the overrun jet barrier 75 feet to right of centerline. Only the left wheel caught the cable and the runout was a sideways slide.

A calm wind condition added to the student's trouble in judging the amount of runway and braking required to stop after a no-flap landing plus the fact that 2500 pounds of fuel was considered excessive in view of the circumstances. As a result the training squadron set up a policy for no-flap landings whereby the pilot will:

- Burn down to a light fuel weight if possible.
- Secure the engine on touchdown.
- Drop the tail hook.

## Helpful

With two miles visibility and an 800-foot overcast the R4D-8 received ATC clearance and was released for takeoff. During takeoff roll the third pilot was occupying the radioman's seat and he noted the proper departure frequency was not set up. On the intercom he asked if he should set the correct frequency. Airspeed was around 80 to 85 knots at this time and the pilot, elbow deep in counteracting a crosswind, shouted an affirmative answer.

The gear had previously been unlatched on orders of the pilot and now upon hearing the pilot's shout, the plane captain, anticipating a command to retract the landing gear, pulled the handle. A slight settling and bump on the port side was believed to be a skip on the port wheel due to a port wing-low crosswind correction. The flight continued for 2.5 hours to the destination without incident or concern.

On shutting down the pilot noticed damage to all three blades on the port prop due to the premature retraction. It is not particularly significant in the course of events, but the port side seems to settle first in a premature retraction. ●

Premature retraction on takeoff (note chewed up prop tips) barely missed being an accident.

# CHOPPER CHUTE STUDY

***As most of you know action has been initiated by NASC requesting that a helicopter bailout project be established to furnish some answers to this problem. However, until some firm answers are forthcoming, we need guidance. In December of 1961 Major Richard A. Bonney, USMC presented a staff study on the problem to Marine Corps Schools, Quantico, Virginia. Only the discussion part of his very worthwhile study is quoted as follows:***

Marine Helicopter Squadrons are at present training with troops in night tactical operations and with aircrews under simulated and actual instrument conditions. This means that for the first time helicopters are operating under conditions not previously normally encountered. The significance of this fact is that for the first time the helicopter is being operated at such altitudes that bailouts become a possible method of emergency escape. Successful autorotations, from a practical viewpoint, cannot be accomplished with presently equipped aircraft unless the pilot is able to see the ground in sufficient time to react.

This discussion may then be broken down into two categories; i. e., *powered flight and autorotative flight.* This must be done because in each phase there are peculiar problems which have no bearing on the other.

### Powered Flight

a. *Contingencies requiring bailout:*

(1) In-flight fires are considered to be extremely serious emergencies. The two factors which combine to make this true are:

(a) the helicopter today is constructed largely of magnesium and

(b) time required to reach the ground, even at a maximum rate of descent, is quite long.

Flight tests which I have conducted show that the approximate rate of descent for the HUS is 3000 feet per minute. This is a maximum and does not represent the normal average rate (about 2000 feet per min.) which would result if the pilot wished to make a successful landing.

I have personally observed the HRS completely consumed by fire in less than three minutes. This particular aircraft was at 500 feet when the fire started and was landed immediately. Even so the investigation revealed that loss of control due to the fire was a contributing factor to the very hard crash landing.

While so far only minimum time to reach the ground has been considered, it may be that circumstances would require that an immediate bailout while in powered flight be executed. In the instance that a suitable landing space is not immediately available, the best course of action would be to bail out rather than risk an autorotative landing in heavily wooded or mountainous terrain even if time permitted and if visual flight could be maintained.

(2) Electrical failure, instrument failure, imminent fuel starvation or lack of adequate facilities to complete an instrument approach and landing are other real possibilities now faced by fixed wing aircraft. These conditions must now be taken into

consideration while operating a helicopter during instrument flight conditions.

(3) Icing conditions during instrument flight are as likely to be encountered with helicopters as with fixed wing aircraft. No accurate data are available concerning the effects of ice on helicopters and no anti-icing equipment is being used on helicopters in service in the Marine Corps. In addition, the present helicopter does not possess the performance capability to fly above many of the icing conditions encountered. Since ice destroys the aerodynamic efficiency of any airfoil and adds weight to the airplane, it is thought this factor is significant without considering the possible problems of upsetting the balance of the rotor system due to an uneven buildup or uneven breaking away of ice.

b. *Problems to be considered:*

(1) No problem exists which is peculiar to the helicopter. In conversations with the Project Director, Project Engineers and Jump Masters at the Naval Parachute Facility, El Centro, Calif., I learned that, during powered flight, the helicopter is preferred over any fixed wing aircraft as a jump platform. Its advantages are that it is slow, has no propeller blast and presents no obstacles with which the parachutists might collide, such as struts, wings or tail surfaces. The only point of significant concern was that opening be delayed until the jumper was clear of the airflow influenced by the main rotor system. This was to preclude any possibility of the canopy or shroudlines becoming entangled in the tail rotor.

In a helicopter bailout, standards for altitude, time required for exodus and delay time before opening are the same as those for any utility or transport type fixed wing aircraft. The possibility of using static lines to give quicker opening time is not considered feasible. During autorotation the upflow of air would carry the static lines into the rotor system unless they were weighted. Weighting the lines would present a hazard to any jumper following the first. An additional difficulty would present itself in developing a way to definitely preclude passengers and crew forgetting to unhook the static lines prior to debarking the aircraft after landing. If the static line were left connected, the parachute would deploy on the ground and present a very grave hazard to both personnel and aircraft because of the volume and velocity of the helicopter down-wash or because of surface winds.

### Autorotative Flight

a. *Contingencies requiring bailout:*

(1) Engine failure requires instantaneous entry into autorotation in order to prevent blade coning and subsequent uncontrolled free fall to the ground.

(2) Fire.

While an aircraft in-flight fire does not necessarily require entry into an autorotation, it will probably be the pilot's first reaction. This is true because immediate reaction is required, and the pilot wishes to minimize the time required to descend while he is deciding the proper course of action, i. e., to make an autorotative landing or to order a bailout. In the case that the fire originated from the engine section, the pilot would wish to stop the engine. An electrical fire would require de-energizing the electrical system, thus shutting off the power to most of the flight instruments and radios. This would negate the possibility of any instrument landing.

b. *Problems to be considered:*

(1) Will a human body clear the main and tail rotor systems in the case of a bailout during autorotative flight?

(a) The terminal vertical velocity of the human body at sea level is approximately 180 miles per hour (15,840 ft/min.). The vertical velocity of an autorotating helicopter is about 3000 feet per minute. Vertical separation, therefore, will occur under all circumstances.

(b) Horizontal deceleration of the human body will depend upon the velocity of the helicopter at the time of bailout and the attitude of the human body in relation to the relative airflow. A body departing the aircraft head first into the airflow will encounter less drag than one facing upright into it. The rate of horizontal separation will vary from zero, in the case of a vertical autorotation, to the maximum at the maximum attainable autorotative airspeed. Since the vertical acceleration remains as a constant factor, the most favorable circumstances would occur at the highest airspeeds.

(c) The direction of the airflow in relation to the tip path plane of the helicopter will vary from straight up in a vertical autorotation to an optimum angle at the aircraft's best range glide speed.

(d) These variables were presented to Mr. V. G. Bockelman, Bureau of Weapons, Project Engineer at the Naval Parachute Facility. Mr. Bockelman was unable to calculate the relative aircraft body positions, and the time factors involved. He advised that the assistance of the Aeronautical Engineering Department of a university be requested in order to determine if and under what circumstances bailouts could be accomplished. He further recommended that subsequent to accomplishing the necessary calculations, the Naval Parachute Facility be requested to initiate an evaluation program encompassing dummy and live autorotative bailouts might be furnished. ●

# MOBILE UNIT GROUND SUPPORT

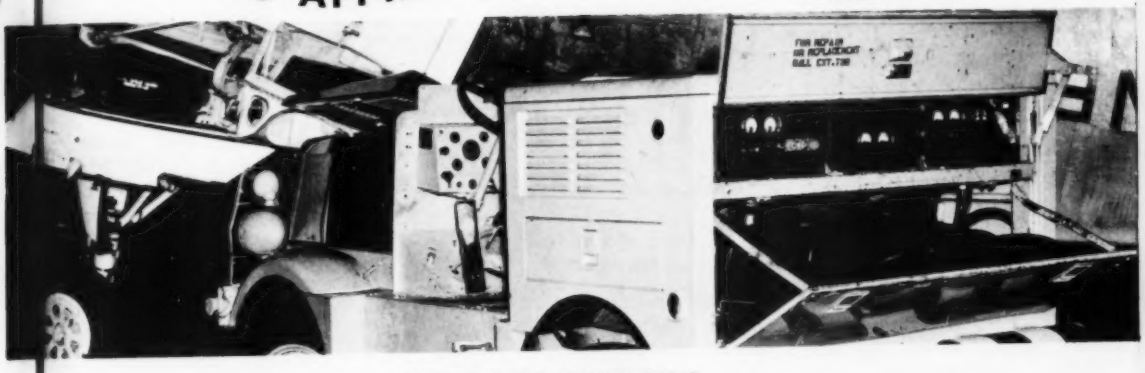
# MUGS

**. . . in an NC-5 starting unit, starts for the Flight Line and for plenty of trouble . . .**

**OOPS . . .**

WRONG APPROACH!

WRONG SPOT!



WRONG PEDAL!

WRONG GEAR!

WRONG! WRONG! WRONG!

# Go via Anywhere-with TACAN

## Point-to-Point Navigation

by CDR M.J. Travers



At times it's amazing to see how casually many pilots take Tacan—that navigation aid of such tremendous versatility. At any air station operations, people file flight plans every day with destination fixes at Miramar, El Toro, Moffett, and so forth. How often do you see a pilot file from the last navaid describing his route, direct to, for example, the 20 mile, 30 mile or 36 mile fix?

Others, although more advanced, try to enter the Tacan holding pattern in the same old way. They aim for the fix and try to apply the LF or VOR method like they'd just got a needle swing—you know, outbound heading for awhile, then a couple of turns and there you are!

**Just like ADF—no sweat.**

There are so many things that can be done with Tacan that the good IFTD instructor must grit his teeth in the face of so little imagination. You can fly low freq airways with Tacan only—legally (although you can't file that way). You can make an approach to a field with no instrument approach (emergency only). You can go from one point to any other point, via anywhere you can go, providing there are no rocks in the clouds or fumes in the tank.

Let's talk about what is called "point-to-point" navigation.

### Simple Point-to-Point Navigation

A discussion of point-to-point Tacan navigation should primarily deal with how to proceed from one point in relation to a Tacan station *directly* to another point defined by the same Tacan, without having to fly to the station or without having to follow an arc.

*Determining Heading*—The ID-250 RMI is used as a simple plotting board. The station is at the center. Your position is at the tail of the no. 2 needle at the distance read from your DME. This sets the scale or radius of the plotting board. Now visualize the point to which you intend to go as a radial and distance on the same plotting board. Estimate the heading and distance, using a pencil if necessary.

An example should help show this technique. In Figure 1, let

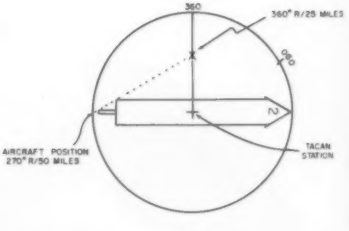



FIG. 1

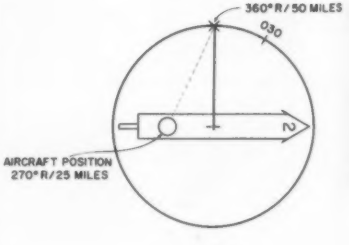



FIG. 2

**CDR TRAVERS, at the present time Ops Officer of VAW-13, flew P-boats and jets, but by his own admission learned to fly instruments after reporting to FAWTUPAC as an instrument instructor. He was Assistant Instrument Training Officer there, then Assistant IFTD in VF-121 (F9F-8T), and later Instrument Flight Training Officer of VA-122 (T-28). He has recently returned from WestPac with a VAW-13 AD-5Q ECM detachment aboard USS MIDWAY**

your position be on the 270° radial at 50 miles. You are cleared directly to the 25-mile fix on the 360° radial. Remember you are at the tail of the needle, 50 miles from the center. Visualize point $x$ as 25 miles (one-half the radius) from the center on the 360° radial. A line connecting your position and point $x$ is seen to give you a course of about 060°. To help read the required course more accurately, lay a pencil between the tail of the needle and point $x$ and then bring it, parallel, to the center. The course of 060° can be read from the dial of the RMI.

If your distance is *less* than that of point $x$, use the distance of point $x$ to set the scale. For example, (Fig. 2) you are at the 270° radial, 25 miles, and are cleared to the 50-mile fix on the 360° radial. Visualize point $x$ on the 360° radial at 50 miles (at the outer edge of the RMI). Your position is 25 miles, or one-half the distance between the center and the outer edge, on the tail of the needle. Connecting the two points visually, using a pencil if necessary, estimate a required course of 030°.

*Determining Time Enroute*—The distance enroute directly between points can be estimated in a very simple manner. Lay a pencil between the two points, measure the distance, and compare it with the radius of the RMI at whatever scale has been selected. For example, the distances in Figures 1 and 2 are the same and appear to be about 1.2 times the radius. Knowing your speed in miles per minute quickly gives you a good ETE.

*Approaching the Fix*—With your course and ETE approximated, you now take up a heading for the fix. Wind, turn radius, and the approximation methods used will make it unlikely that you arrive *exactly* at your point by holding your heading. However, you don't mind since the following technique will get you as close to it as you wish.

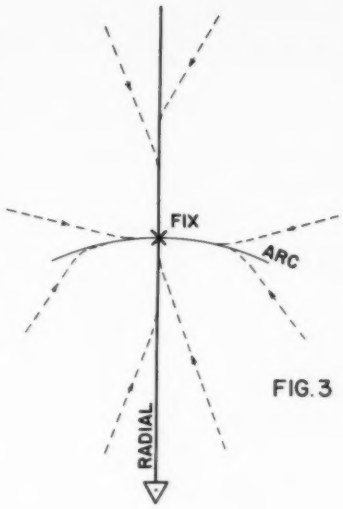



FIG. 3

Refer to Figure 3. A fix is defined by a radial and an arc. As you near the fix, you will approach either the arc or the radial first. Merely adjust in the proper direction, following the arc or radial if necessary, to arrive at the desired fix.

## Point-to-Point Holding Pattern Navigation

When cleared from one point to another on Tacan, you are most often cleared to a holding fix. With LF or OMNI, you would have been cleared to the station or to a fan marker or other intersection, and would have to fly *over* that point for a positive navigation check in order to accurately enter the holding pattern. With a Tacan holding pattern, since it is not possible to consistently hit the fix without following an arc or radial, we find it better to enter the holding pattern along a *deliberately chosen* arc or radial.

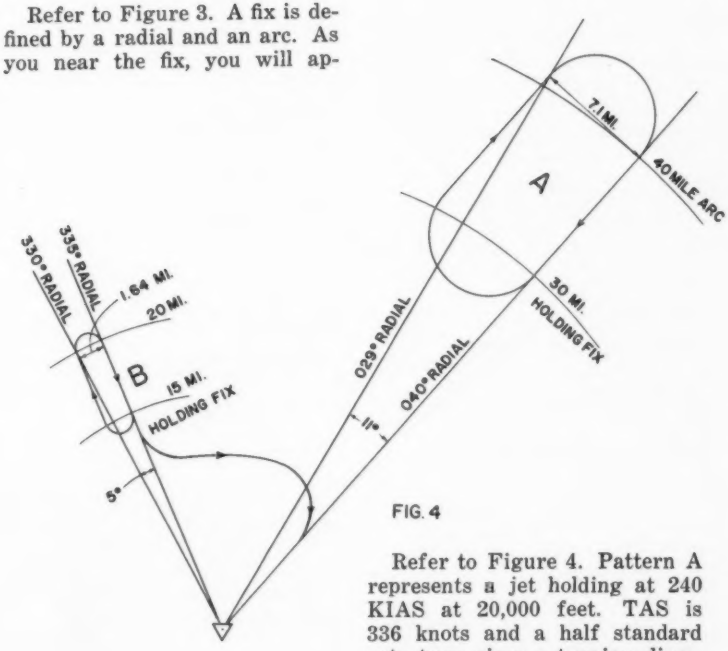



FIG. 4

Refer to Figure 4. Pattern A represents a jet holding at 240 KIAS at 20,000 feet. TAS is 336 knots and a half standard rate turn gives a turning diameter of 7.1 miles. The radial defining the outboard limit of the holding pattern has also been included.

A little study will show that, depending upon direction of approach, the pattern may most

easily be entered by intercepting one of the following in the appropriate direction:

40-mile arc
30-mile arc
040° radial
029° radial

Pattern B represents a prop aircraft holding at 140 KIAS at 5000 feet. TAS is 154 knots and a standard rate turn gives a turning diameter of 1.64 miles. Again it can be seen that an easy entry may be made by intercepting one of the following:

20-mile arc
15-mile arc
335° radial
330° radial

It is not necessary to compute the radial of the outboard corner for each holding pattern to be entered, but it is very easy to do so. In Figure 4, the outboard radials were determined by using the pattern width (turn diameter) with the radius as a simple proportion of a 60° radian:

$$\frac{\text{Pattern Diameter}}{\text{Radius (DME)}} \times 60° =$$

Outboard Pattern Width (degrees)

$$\frac{7.1 \text{ miles}}{40 \text{ miles}} \times 60° =$$

10.65° rounded off to 11°

$$\frac{1.64 \text{ miles}}{20 \text{ miles}} \times 60° =$$

4.9° rounded off to 5°

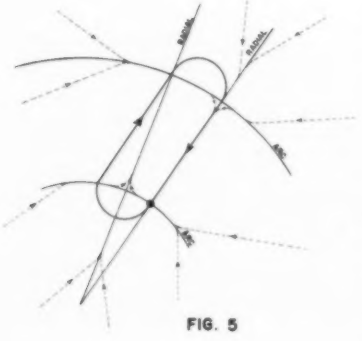


FIG. 5

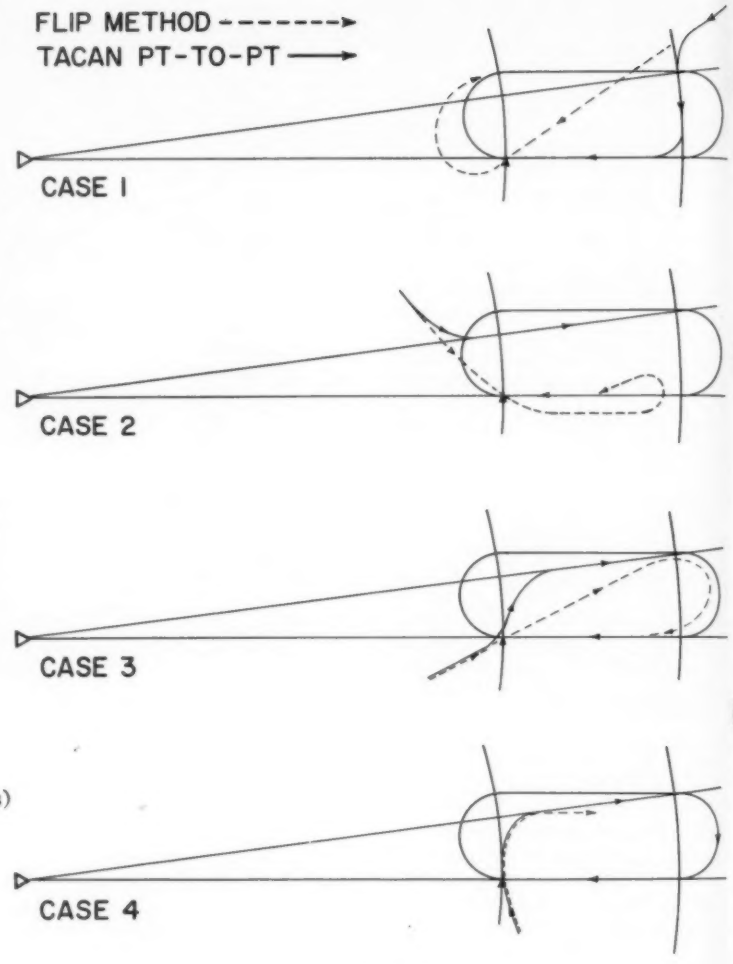



FIG. 6

If the outboard radial has not been computed, a 10° difference for jets and 5° for props will take care of most average situations.

Figure 5 shows some of the methods of pattern entry.

Since 11 January 1962 new methods of entering holding patterns have been instituted and published in the FLIP Planning document. Examination of these newly-published (although not "new") methods show that they have been predicated, as in the past, primarily with VOR or other navaid in mind, the type that requires station passage for a positive fix. While a Tacan fix more accurately positions the aircraft, it is apparent that actually entering a Tacan holding pattern exactly at the fix is difficult to do if proceeding directly point-to-point. It is for this reason that entry at the most convenient radial or arc is the only practicable way to insure hitting the fix exactly. The above methods do not violate any required published procedures;

in fact, they are smoother and more accurate than methods afforded the VOR (without DME) or LF-equipped airplane driver.

For emphasis and comparison, the applications of the point-to-point method are superimposed on the patterns outlined in the FLIP Planning document (Fig. 6). It can again be seen that the Tacan methods are more accurate and use less air space:

## Point-to-Point Along an Arc

Although flying along a Tacan arc is not direct point-to-point, it is an obvious corollary. Determining which direction to go and flying on the arc with a wingtip needle is no problem for most pilots. It is a little more difficult to estimate distance and thereby determine ETE.

First of all, we know by geometry that a *radian* is an angle at the center of a circle which subtends an arc of the circle equal in length to the radius. This is an angle of about 57.3°, but for simplification, we'll use a 60°

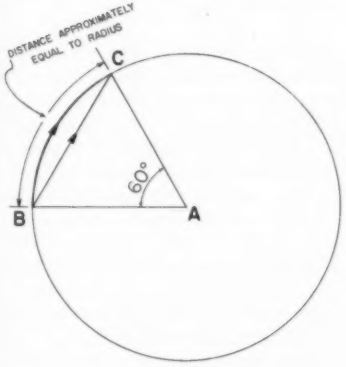



FIG. 7

angle. Refer to Figure 6. The direct distance BC is equal to the radius of the circle. The distance BC *along the arc* is a little more, but not enough to matter for our purposes. Therefore each 60° of arc will be a distance equal to the radius of the arc being flown. To determine the distance to be traveled along any arc, break down the arc into multiples or fractions of 60°. The distance along 90° of arc at a distance of 30 miles from the Tacan station would then be 1½ times 30, or 45

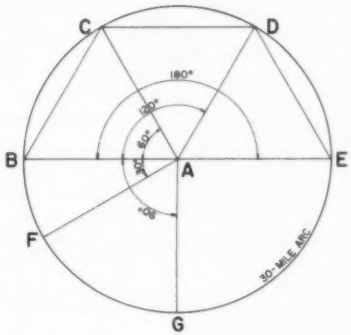



FIG. 8

miles. Let Figure 7 represent an arc with a 30-mile radius. Then check the following distances *along the given arcs*:

BC = 60° = 1 × radius = 30 miles
BCD = 120° = 2 × radius = 60 miles
BCDE = 180° = 3 × radius = 90 miles
BF = 30° = ½ × radius = 15 miles
BGF = 90° = 1½ × radius = 45 miles

Applying your speed in miles per minute will give you ETE.

A practical problem is shown

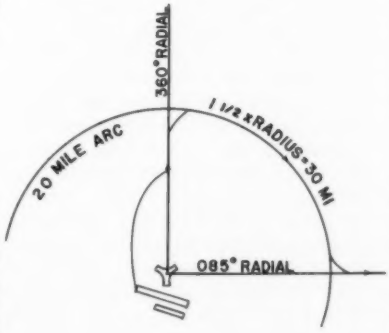


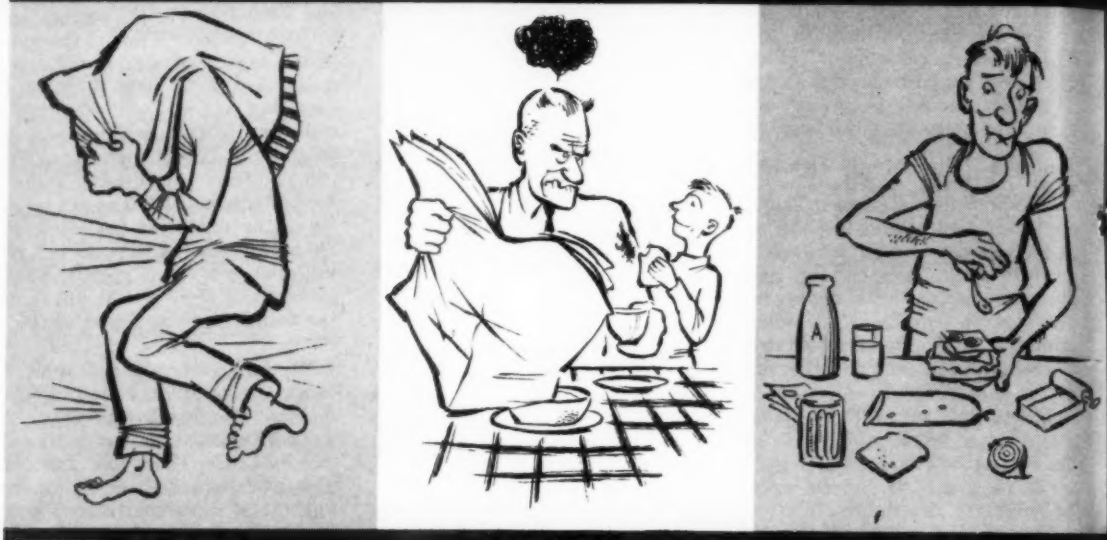

FIG. 9

in Figure 8. You are cleared for a right turn after takeoff, to intercept the 360° radial, proceed outbound, intercept the 20-mile arc, proceed clockwise to intercept the 085° radial. Remain below 2000 feet until intercepting the 085° radial. What is the distance traversed prior to commencing climb? From takeoff we turn and proceed out about 20 miles to intercept the arc. A total arc of 85° is covered. We'll call it 90° or 1½ radians. Therefore, distance along the arc is 1½ times the radius of 20 miles, or 30 miles. Adding this to the 20 miles we flew to intercept the arc gives us a total of 50 miles to the point where we may start our climb.

In the opening paragraphs it was mentioned that you can fly on low frequency airways. At present there is little practical value, other than the use of already precomputed minimum enroute altitudes, but here's how it's done. You are permitted to file between Tacan *fixes* direct. So you must file for the Tacan fix occurring over the LF (or VOR) stations or intersection. This is awkward, and most centers still seem to want a two-radial intersection and probably won't give you a hard altitude, but it still can be done and again demonstrates the tremendous versatility of Tacan. Perhaps one day we'll be able to file for "Amber 1 (Tacan)", or "V-25 (Tacan)". It would certainly save a lot of writing. Perhaps the day will come when we will have Tacan airways?

*Conclusion*—The possibilities and methods of point-to-point Tacan navigating have in no way been exhausted here. All instrument pilots, however, should be familiar with at least the few techniques explained above. Try them on paper first while sitting in that old easy chair. Next fly them on a bright sunny day. Then see if you don't relax a little on the gauges that next dark, stormy night. ●

# SAFE



SLEEP ATTITUDE FOOD



The other night ole Brokenbones and his buddy P. Wellington Skagdragger had occasion to consume about five thousand of the Carolina Coast's finest fish and lap up a few ounces of that California type grape juice, and, as is our wont, we got to talking about the old days.

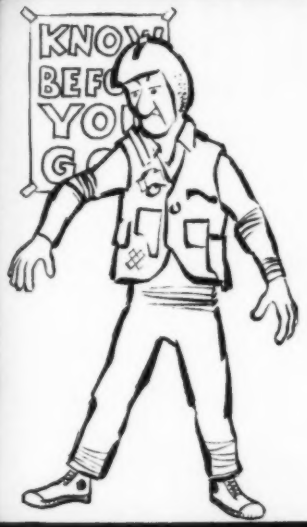
As the wives clucked contentedly in a corner, disclaiming all knowledge of anything back beyond 1936, the sea stories began to fly thick and fast, most of them about pilots. Just as we had both concluded, philosophically "Those were really men in them days" it occurred to both of us that maybe the reason we had always felt that way is because the ones who are still around, smashing bugs and boring holes in the sky were the smart ones. This launched a long discussion of pilot types, and BB scratched some notes on the back of a cocktail napkin with a toothpick soaked in grenadine, and, for what they're worth, here they are:

Back in the early days of aviation, there was something mysterious about an aviator. First of all, anyone would tell you, it took a fellow who was basically an idiot to climb in one of those crazy things and go off into the sky with nothing holding him up. And the aviators dressed, looked, and acted the part. They effected strange getups, and did all sorts of things to perpetuate the illusion like flying through barn doors and walking on wings. Maybe a lot of this was an effort to get rid of some of the anxiety they felt when they looked at that heap of baling wire and doped silk, and wondered if it'd hold together one more time. They were tempermental about those airplanes. They had to be. And, just in keeping with the part they were playing, many of them were temperamental about themselves.

Then came a couple odd wars, and a lot of the romance went out of the public attitude toward aviators. Even the military services began to allow as how they wanted them to act like all the rest of the people, and, with a respectable amount of respectful grumbling, they did.

But the big thing was that people from all over, from every possible background, began to fly. And it became more fashionable to adopt an attitude of "I can fly anything with an engine in it, drunk or sober, sick or well" about which legends were built during the Wars.

Very few of the old reliable types ever used, or adopted this attitude, but it caught on with a few people, and it became con-




# EQUIPMENT

tagious, sort of romantic and daring. And it provided jobs for a whole bunch of poor, broken down medical types who called themselves Flight Surgeons, and who are busy trying to dispel this attitude.

When the people up at Igor's place built that aircraft for you, they bolted to the panel a little thing called a checkoff list, realizing that people being what they are, if such a list was put in a position of maximum availability, people might use it, and this might save a broken airplane or two. People do use this list, and it does reduce accidents.

The Medics are busy now trying to determine the best site to tatoo a personal checklist on each pilot, but are encountering some degree of resistance. So from now until the day you quit flying, you'll hear the Flight Surgeons screaming loud and long about this personal, human type checklist. BB has one he always uses, and it's so simple that even he can remember it without a neon sign to twit his memory. Let's go over it and see what *you* think of it.

First item on the list is *sleep*. You should have had at least seven or eight hours the night before, maybe more, depending on your individual needs. Along with this goes general physical condition, good muscle tone, moderate exercise and no excess weight on the frame. And that seven or eight hours of sleep supposes an equal amount of time without any effect or trace of alcohol in your system to hang over, with toxic end products, and reduce your efficiency. If you had to be carried to bed, then eight hours of sleep wasn't enough for you. All you were doing all that time was oxidizing alcohol, and, come morning, your frame is just beginning to repair some of the damage that it sustained. It isn't even nearly ready to go aviating yet.

Next thing listed is *attitude*. As sleep encompasses a lot of related things, so does this item: your basic attitude toward flying on that particular morning. What influenced it? Have a fight with the wife? Kids spill jelly on your freshly cleaned shirt? Get chewed out by the skipper? Car payment overdue? If you find your mind a mess of worries, you can't check this item as safe. If your attitude of the moment is enough to keep you from devoting your full attention to the job, then just stop right there, and execute that famous 180-degree maneuver right there on the mat and come back to the ready-room. There also may come a day when this whole flying business has got you filled up to there, and if this ever hits you, don't brood about it, talk about it to your CO and your flight surgeon. Many times these things can be talked out, and it's a wise man who does that instead of stewing about it, which never did anyone any good.

Another item is *food*. Did you have a good breakfast rather than a doughnut and coffee, a cigarette and coffee, just a cigarette; or nothing at all? You can't run without that precious blood sugar, and you can't get it unless you eat that breakfast. So shake the wife out of the pad and shove an egg and a skillet into her hand and tell her to get fryin', that you've got to go flyin'. Or set the alarm 30 minutes early so you can stop at the mess for breakfast on your way to work. But don't try to operate without fuel.

Finally, check on *equipment*. Is yours all present and accounted for? Or did you leave your knife at home after you used it to clean those fish? Today, it would be just your luck to have to use it. What kind of shoes are you wearing? Would you like to walk home in them? When was the last time you preflighted your mae west? Do you have a survival kit? What would you do if you were forced down in the booneys??????! Check that equipment with loving care.

Just four items, and, whatdya know, you can even put them together to spell something: Sleep, Attitude, Food, Equipment. That spells S * A * F * E. If you smoke a certain cigarette you can tatoo it on your hand. But it's easy to remember anyway. Check it on your way to the line shack for that next hop. *Sleep*—plenty, the right kind, in basically good shape so that it can do you some good in the first place. *Attitude*—a desire to fly and an ability to devote all your attention to it. *Food*—recent, and of the proper kind to keep your turns up. *Equipment*—to get you home safely. Check this list as though your life depended on it. It does.

*—Adapted from "Main Transmission" published by MAG-(HR)L-26* ●

# Drogue Gun Jaw Breaker



DURING rework of an F9F-8T both Martin-Baker ejection seats were removed from the aircraft. They were completely inspected, reinstalled and left unarmed overnight. The following morning two ejection seat maintenance men were assigned to arm the seats.

Mech A armed and secured the rear seat. He then proceeded to the front cockpit to assist Mech B. Sitting on the rear cockpit windscreen, Mech B safety wired the main catapult mechanism. Mech A noticed that the drogue gun was completely installed except for the safety wire from the barrel of the gun itself. He proceeded to install it and applied the lead seal. He stated later that at this time the safety pin was not installed and had fallen behind the seat.

After retrieving the safety pin, Mech A attempted to install it in the drogue gun but experienced difficulty. Mech B then attempted to install the pin but was also unsuccessful. Mech A then applied pressure to the end of the pin with the handle of a pair of pliers. From his vantage point atop the aircraft, Mech B observed the operation with his head approximately over the mechanism.

At this time the drogue gun fired.

The steel bar struck Mech B in the left lower jaw. It passed through his jaw and emerged about one inch below his left ear. The attached drogue parachute remained wedged in the wound. The force of the blow lifted Mech B off the aircraft. He fell to the hanger deck alongside the front cockpit. Mech A jumped down from the work platform, ran into the maintenance office to get help for the injured man, then fainted.

Mech B's injuries will keep him on the sick list for approximately six months.

Investigators found the rear seat properly installed, armed and safetied. On the front seat, the primary firing head was found improperly safety wired with the safety pin installed. The drogue gun had been fired, the safety pin was partially inserted,

the sear was in place, and the firing arm was attached to the bulkhead.

The accident board was of the opinion that the two mechs lacked thorough and complete safety training regarding the dangers of working with ejection seats. The board felt that the safety education program within the safety equipment section was inadequate and the number and grade of personnel assigned was insufficient to meet work and support requirements of the organizations assigned to the Air Group. Since this accident, action has been taken to remedy these deficiencies.

## No Flotation Gear

AFTER a rapid decrease of RPM and a loss of power, the HRS-3 hit the water tail first. The fuselage "dug into the water" and rolled up on its nose. It sank immediately in about 12 to 15 feet of water. Both pilots released their safety belts and swam through the pilot's hatch.

*Neither life vests or life rafts were worn by the occupants of the aircraft. The pilots experienced swimming fatigue in the short period before they were picked up by the crash boat.*

## Inaccessible Vest Toggle

WHEN an A3D went into the water after a hard carrier landing during night operations, the cockpit section broke from the fuselage and pitched down, creating an opening through which the three crewmembers escaped underwater. The bombardier navigator assisted the pilot when he surfaced completely exhausted from having swallowed a great deal of water.

Since the pilot was in no condition to inflate his Mk3C life preserver, the bombardier navigator pulled the right toggle. He couldn't find the left toggle. Later, on inspection the left toggle was found tucked inside the flap on the preserver cover in such a way that after the upper section of the preserver had been inflated by the right toggle, it was impossible to get the left toggle out.

The survivors were rescued by carrier whaleboat after 35 minutes in the water.

## "Two-Bit Lecture"

DURING night carquals, the pilot had just made the third pilot switch and was at the controls of the HSS-1. As he began his turn upwind in the starboard delta pattern at an altitude of approximately 150', the helicopter experienced a partial power loss and struck the water in a nose high attitude with very little airspeed.

The pilot managed to recover momentarily but then struck the water a second time. Again he recovered but sufficient water had entered the tail to require full forward cyclic to regain airspeed. The pilot declared an emergency and made a relatively normal landing aboard the carrier.

At the first impact the aircrewman loosened his seat belt and started toward the hatch. He said later that the only thing that stopped him and made him sit down again was the pilot's "two-bit ditching lecture" before takeoff. If the crewman had abandoned the helicopter, he would have been left adrift when the pilot finally succeeded in pulling the aircraft out of the water the second time. In all probability the crewman's absence would not have been discovered until the aircraft was back on deck.

"I attribute my health and well being entirely to the pilot's review of ditching procedure," the crewman later stated. "I don't believe that remaining in the aircraft until the proper time to leave it can be stressed enough."

## PRT-3 Plug

FINDING himself in an uncontrollable spin under heavy G forces, an F8U-2 pilot pulled the alternate firing handle and ejected successfully over desert terrain. He was picked up an hour and a half after the accident.

While awaiting rescue, the pilot noticed his PRT-3 disconnect actuation plug hanging loose. Believing it to be necessary for operation of the radio, he reinserted the plug. When he did he silenced the PRT-3 and rendered ineffective the only homing equipment installed aboard the rescue helicopter.

## The Human Back Up

SINCE automatic personal survival equipment can and does fail to operate correctly on occasion, every pilot and crewman should monitor his equipment so that he can take over manually at any time.

After several unsuccessful relight attempts, an FJ-4 pilot ejected at 6500 feet over the terrain. The ejection itself was successful, but the automatic seat belt actuator failed to function. After free falling for approximately 30 seconds, he manually released himself from the seat and immediately pulled the parachute rip cord. The chute deployed as he separated from the seat at 2500 feet. After a few severe oscillations which he stopped by manipulating the risers, he descended to an uneventful landing in the vicinity of the field. He was rescued by helicopter.

The pilot credited his survival to repeated review and practice of emergency procedures. Accident investigators termed his handling of the automatic seat separation failure "admirable." His freedom from panic and his knowledge of emergency procedures saved his life. ●

# Quality Control in the Use of O-RINGS

by
Robert D. Saunders

**The proper use of O-ring packings cannot be overemphasized; their importance to the critical parts of the control systems of our high performance aircraft and missiles cannot be overstressed. This is an attempt to share experience and research items that could help bring a better understanding to those with limited experience with O-ring seals and their uses.**



The correct application, use, and maintenance of O-rings are a must if we expect to attain the safety that was designed into our operable vehicles.

To assure proper use and maintenance practices in the use of O-ring seals, the engineer and technician must have an understanding of how they work, their applications, their limitations, types of failures and the causes and remedies, and the recommended practices that have proven to increase the integrity of the O-ring seal.

Statisticians try to determine failure rates and life expectancy of the many units using O-ring seals, but it is doubtful that they are furnished with the correct O-ring data. The usual practice is to report the unit failure, i.e., control valve, hydraulic cylinders, actuator, . . ., instead of the O-ring component that failed to perform its function.

## Over 200 Sizes

Packing rings, with a circular cross section, were used in the late 1800's. Prior to 1942, when the Air Corps published tabulated lists of correlated O-ring sizes, each user had his own size/gland relationship.

Today there are over 200 standard sizes and there are still some designers that unnecessarily use non-standard sizes in their applications. The SAE Subcommittee AE-6A on Elastic Seals has prepared ARP-568, which sets forth a standardized dash numbering system for O-ring sizes. If this standardization is universally accepted by manufacturers, the military, and other standard drawings for O-ring sizes, we will eventually have a replacement of the variety of conflicting and overlapping systems now in use and we can expect a marked improvement in the confused condition that now exists.

## Elastomers Replace Rubber

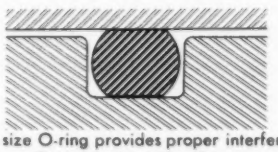
The early O-rings were manufactured from rubber, and had limited application due to incompatibility with most fluids and environmental conditions. With the development of the modern oil and chemical resistant elastomers, you find O-rings replacing the old chevron and V-ring packings in aircraft hydraulic equipment. Where the

replacements were made, the previously established standard relationship of nominal cylinder, piston, and rod dimensions were maintained, thereby influencing the standard sizes we have today. This approach has benefited us by reduced problems in design and maintenance, and has greatly increased the reliability of performance in sealed joints.

## Sealing Principle

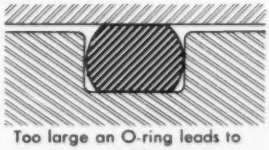
An O-ring seal is a means of closing off a passageway, preventing an unwanted escape or loss of fluids or gases. All fluid and gas tight seals are characterized by the absence of any passage by which there could be an escape. The O-ring differs from the welded, brazed, soldered, lapped fit approach. Consisting of a softer material between two harder and stiffer members of the structure, the O-ring material is incompressible and pliable and will distort to increase sealing efficiency in the area as the pressure is increased. The amount of distortion is proportional to the hardness of the material. This hardness is expressed in a Durometer Shore "A" reading 40, 50, 60, 70, 80, 90, . . .; the lower the number, the softer the material. The softer material would be used under lower operating pressures. It is recommended that a Shore 70 "A" be used on hydraulic pressures up to 1500 psi, a Shore 80 "A" to 2500 psi, and a Shore 90 "A" at pressures above 3000 psi.

The O-ring seal operates by distortion to create zero clearance. The physical dimensions of the gland establish the amount of distortion, so it is very important that gland dimension be such that it will be compatible with standard sized O-rings and the compounds from which they are made. If all tolerances were zero and shafts and pistons ran true in their bores, it would be possible to reduce the number of compounds required. This is impractical so the compound material must make up for the tolerances of manufacture and application.



Correct size O-ring provides proper interference fit between O-ring and metal surface.

Too small an O-ring results in an ineffective seal.



Too large an O-ring leads to installation problems, excessive friction, and deformation of the ring in its groove.

## Selection of Compounds

The compound is selected for a particular and exacting application recognizing the following factors:

**Size**—Friction increases as the area contact of the O-ring rubbing against the metal parts increases, thus an increased O-ring cross section or increased diameter creates increased friction. Increased squeeze on the initial fit has a great influence on the amount of friction. Standard aircraft sizes are an attempt to compromise all factors and have been determined through years of experience and research.

**Fluid Pressure**—O-ring friction increases with fluid pressure up to the maximum distortion pressure of the O-ring. The present AN 6227 O-rings reach maximum distortion at 1200 psi, but they are used in 3000 psi systems if used with anti-extrusion rings made of leather or teflon. There are two types of friction to be considered:

*Running Friction*—This friction is present in all types of seals, but is probably lessened with the use of O-rings.

*Breakout Friction*—This friction is the resistance to the force required for the initial movement and is very important in the servo systems of the primary controls on our modern aircraft. If these forces are high they can cause porpoising or erratic motion of the aircraft and in a fuel system they cause surging. It has been found that a Durometer Shore "A" 68 is optimum for sealing and reduced break-away friction in a properly correlated O ring/gland design in a medium pressure hydraulic system (3000 psi). The higher the Durometer Shore "A" reading, the higher the break-away friction will be. Just the opposite is true of the sealing characteristics.

**Temperature**—O-ring friction and hardness increase with temperature decreases. The O-ring must be able to reach maximum distortion at −65°F and not exceed maximum distortion at limit temperatures. The limit temperatures can range as high as 500°F for some applications.

**Compatibility**—The material must not be affected by the fluid, either through chemical action or operational characteristics. A reasonable swell can be tolerated, but a shrinkage cannot.

**Resilience**—The ability of the compound to return to its original shape. Some O-ring compounds may not be chemically attacked by a fluid, but the resilient qualities could be lowered below the point of acceptability.

**Aging**—Measured in percent loss, this can occur in the operable system and on the shelf storage. It can determine the life expectancy of the unit involved. From the preceding information it can be seen that any loss in the O-ring would disrupt and void the careful design engineering of the O-

ring/gland configuration. On the shelf aging can vary greatly. It has been determined that, under proper packaging, the shelf-life is five years, but in an unpackaged condition, where exposure to light and changing atmospheric conditions exist, storage life is variable and questionable.

## Causes of Failure

Some of the causes of O-ring failure are:

● High abrasive wear, usually the entrance of foreign particles that destroy the surface finish of the metal on which the O-ring rubs, causing a high rate of wear on the O-rings. The finish of the metal surfaces can also be destroyed by corrosion. The finish of some metal surfaces is too rough when received from the manufacturer. Foreign particle damage can be minimized by the use of micronic filters in the fluid system and the use of specially designed scrapers on the externally exposed shafts.

● Extrusion is the forcing of the O-ring into the clearance gap between the metal surfaces. The extent of the extrusion depends upon clearance, fluid pressure and the physical properties of the O-ring compound, or any combination of these. The extrusion process causes large cuts to be formed in the O-ring and eventual flaking off of the material, which contaminates the system and causes leakage. Pulsating pressures that cause this extruding in the dynamic seals are also great enough to cause the same failure on a static seal. The maximum clearances for a compound with a Durometer Shore "A" hardness of 70 are .010 inch to 250 psi, .008 inch to 500 psi, .005 inch to 1000 psi, and .003 inch to 1500 psi. When pulsating pressures are expected to approach or exceed these limits, anti-extrusion backup rings are necessary.

● Spiral failure is the twisting of the O-ring on itself. Spiral failure can be caused by:

a. O-ring carelessly installed in a twisted or unlubricated condition, or both.

b. Eccentric parts or side thrust on piston from external loads which produce uneven squeeze and friction.

c. Improper gland O-ring relationship which may be caused by a slightly smaller than design O-ring being stretched into the groove destroying the gland volume/O-ring volume relationship established by engineering. (Remember, this is critical. The gland design was for a particular size O-ring and a particular compound. There are no substitutions except on complete engineering information.)

d. O-ring groove surface being too smooth, permitting O-ring roll through higher drag on the cylinder wall.

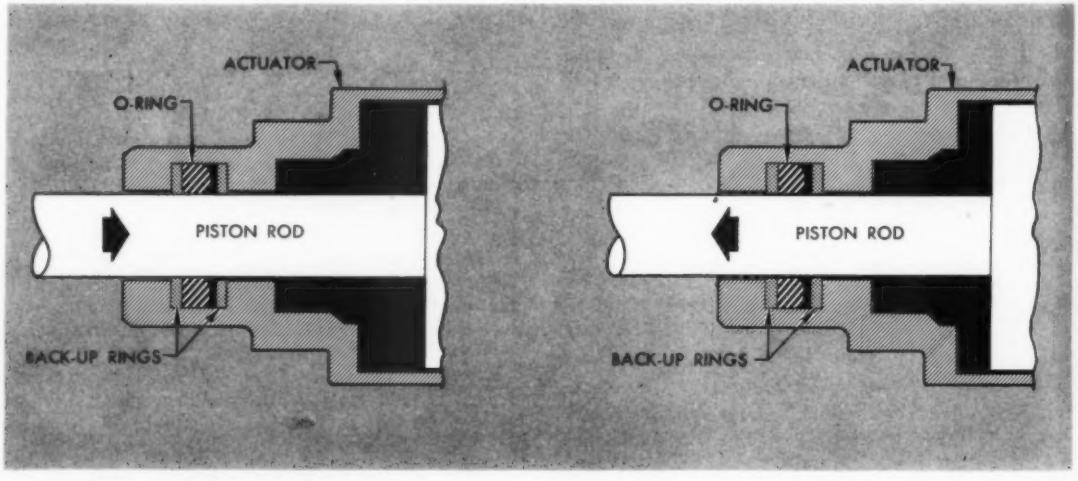
e. Uneven wall finish due to any reason: corrosion, scratches, . . . Remember wall finish for O-ring operation is measured in millionths of an inch and it is desired that the wall finish have an average value of surface roughness of 16 millionths of an inch or less.

f. Loss of lubrication in the operation.

## Rules for Installation

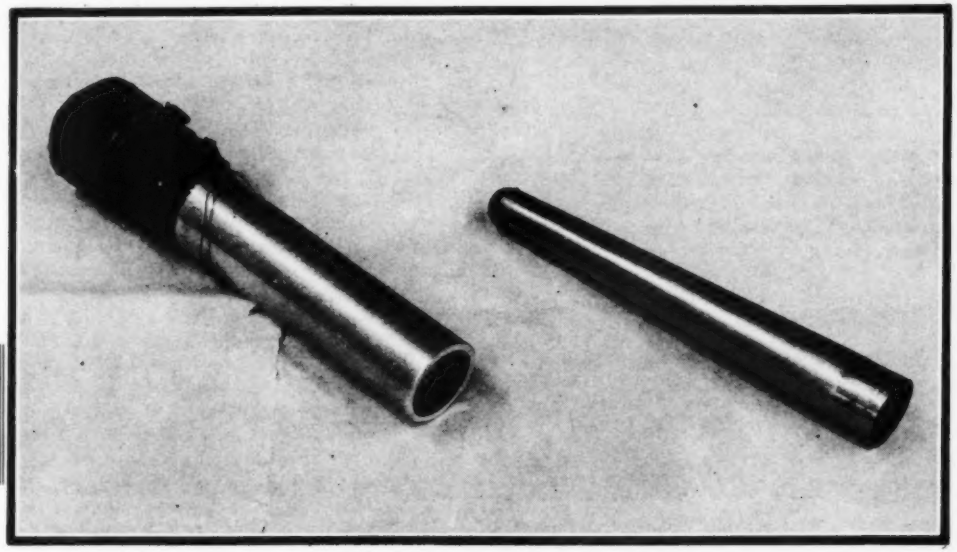
Only the trained technician should attempt to disassemble, overhaul, and test the many units that use O-ring seals. Some of the general rules





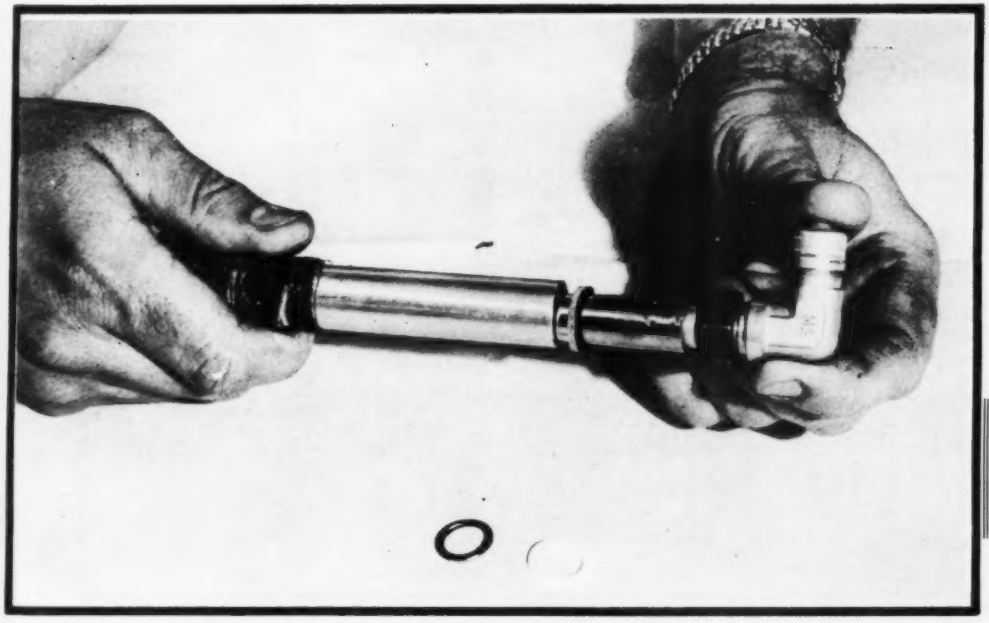

O-ring Pumping Action. Rolling action of O-ring squeezes or pumps out minute quantity of fluid at each cycle of pressure change.

## O-Ring Installation Tool



A bullet of this type will aid in installing O-rings and gaskets which are difficult to install over threaded elbows and nipples. O-rings, leather or teflon, are placed on the small end of the bullet. Inside the large end of the bullet is a recess where the threaded part of the elbow or nipple will not hang up on the threads. O-rings being installed are pushed up over the threaded part of the elbow or nipple and will drop into position.





O-Ring removal tool of this type has proven ideal for removing rings and gaskets from inaccessible areas.



for the installation of O-ring packings are listed below. (An O-ring packing is an O-ring that is used as a dynamic seal and is used as a gasket for static sealing under applications requiring the softer compounds when dependence on fluid pressure is necessary for the distortion and sealing of the O-ring.)

► In a clean area, free from dust, disassemble the unit in which the packing is to be replaced only far enough to replace the defective packing and to examine and analyze the surfaces which it contacts.

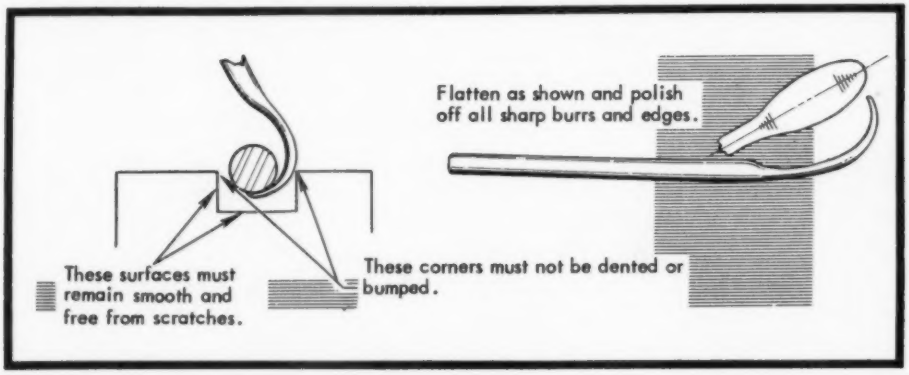
► Check the parts catalog and the latest technical information on the unit involved for identification of the proper part numbers for current installation. (The AN and MS numbers reflect the material, the size, the fluid and the temperature operating range.)

► Accept from the stock supply only packings that are individually packed and properly identified as to part number, manufacturer and cure date. (SAE specification AMS 2817 covers this requirement.) Do not accept packings that are over five years from cure date. This information cannot be assured on packings stored loose. Do not allow supply personnel to substitute part numbers unless they can furnish a recognized technical authority for a superseding part number. Remember you are the trained technician in this field. (The AN 6290 O-rings are superseded by MS 28778 O rings and they carry the same stock number). There are or will be other supersedures in the future, but it will take years to transmit these supersedures to the many parts catalogs and overhaul information on the many units involved. It is hoped that specifications will be amended to include superseding information in the printed information on the O-ring packages.

► Examine new O-ring packings for defects, size, and for proper markings as set forth in the applicable AN, MS, or manufacturers' drawings. Reject all rings not properly marked or defective.

► Carefully examine O-ring grooves for burrs, nicks, corrosion and contamination and have full assurance that the O-ring is in proper condition for installation.

► Where the use of anti-extrusion backup rings is required, *pay particular attention to the scarf edges on the teflon spiral ring so ring will not be installed in a reversed position.* The teflon ring is preferred over the leather backup ring. The leather backup ring should be installed with the hair (smooth) side toward the O-ring. Both types of backup rings are installed on the side of the O-ring away from the fluid pressure. A leather backup ring, soaked in hydraulic fluid or oil and


Flatten as shown and polish off all sharp burrs and edges.
These surfaces must remain smooth and free from scratches.
These corners must not be dented or bumped.

# Proper Installation of O-Rings in AN Fittings

The amount that the AN universal fitting is screwed into the boss or other component unit determines the final position of the O-ring. If the fitting is installed too far into the boss, tightening the locknut will force the O-ring into the threads of the boss. If the fitting is not installed far enough into the boss, tightening the lock-nut will force the O-ring across the fitting threads. Either of these conditions will cause the O-ring to be cut and its sealing value will be lost.

Careful observance of the following illustration of procedures will prevent damage to the O-ring.

### Installing O-Rings with Back-Up Rings (see figure 1)

1. Coat the O-ring and male threads of the fitting sparingly with the appropriate fluid for the system in which the fitting is to be used and assemble the O-ring and back-up ring on the fitting as shown. Work the backup ring into the counterbore of the nut and turn the locknut down until the O-ring is pushed firmly against the lower threaded section of the fitting.

2. Install the fitting into the boss by turning the locknut and fitting it together until a slight resistance is felt. Do not allow the nut to turn on the fitting.

3. Hold the locknut with a wrench to prevent it from turning and, at the same time, turn the fitting an additional 1¼ turns into the boss. The fitting may be properly positioned in relation to its connecting lines by turning the fitting *in* no more than one additional turn.

4. Hold the fitting and boss stationary and tighten the locknut against the boss to complete the installation.

### Installing O-Rings Without Back-Up Rings (see figure 2)

1. Assemble the locknut on the fitting until washer face of locknut is aligned with upper corner of O-ring groove. Coat the O-ring sparingly with the appropriate fluid for the system in which the fitting is to be used and place the O-ring in the fitting groove so that it contacts the locknut.

2. Install the fitting into the boss by turning the locknut and fitting together until O-ring contacts boss.

3. Position the fitting in relation to its connecting lines by turning it *in* no more than three fourths turn or by turning *out* no more than one fourth turn.

4. Assemble the connecting line to the fitting and, holding the fitting stationary in the selected position, tighten the locknut.



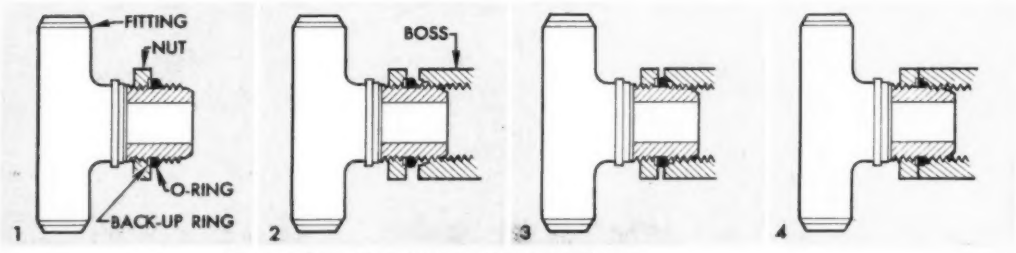



Figure 1 Installation of O-rings With Back-up Rings

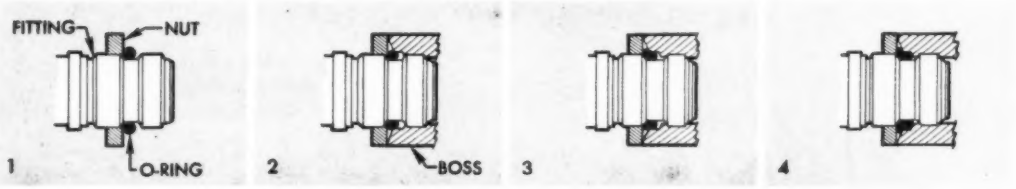



Figure 2 Installation of O-rings Without Back-up Rings

stretched into position will not fully shrink and is a continual source of trouble. To ease installation of leather rings, it is suggested that they be soaked in water, then use a minimum amount of stretching to position the ring. Allow to dry and shrink before assembly of the O-ring is attempted. An infra-lamp will accelerate the drying and shrinking, but be careful not to overheat.

► Before installing an O-ring packing, lubricate it with the fluid that is used in the system and install while still wet. If installed in a pneumatic system, use an approved grease; a grease containing molybdenum disulfide ($MoS_2$) is recommended.

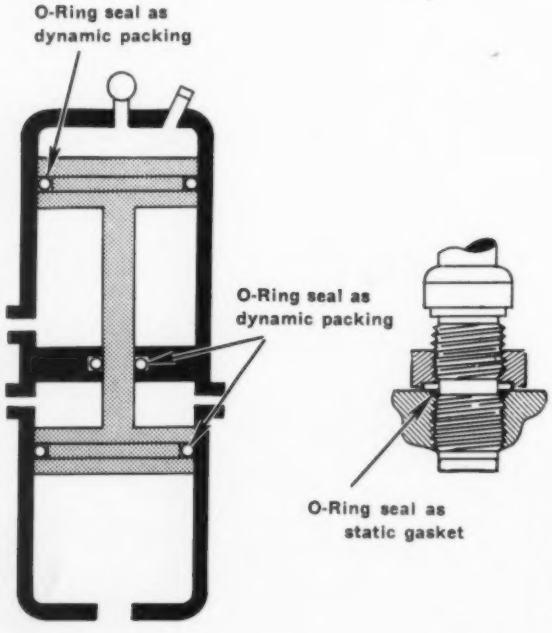
► Do not stretch a packing ring any more than absolutely necessary while installing it and do not use sharp tools or instruments.

► After fitting O-ring into place, gently work or roll the O-ring to remove any possible twist. The medium and large sizes have a tendency to twist on assembly.

► Use plastic tape or a thin thimble (.001 inch brass shim stock) to protect the O-ring when installing over threaded shafts or sharp edges. After installation, remove the protection.

► The technician should always consult the overhaul and maintenance instructions for the particular unit on which he is working to be assured of the recommended installation and removal procedures and that the proper parts are being used.






**Robert D. Saunders—Head of the Flight Inspection Section of the Aero-Space Mechanics Division of NASA, Langley Research Center. Has been at NACA/NASA since 1936. Twenty-three of the twenty-six years at NACA/NASA have been in inspection and quality control covering all aircraft from the old Navy XBM-1 through the XF8U3. During World War II he spent several hundred hours flight time flying and operating equipment in the NACA Ice Research and Control Program.**

## O-Ring Gaskets

An O-ring seal is classified as a packing when installed as a dynamic seal and as a gasket when installed as a static seal; the use of a named packing as a gasket was covered in preceding information. The use of an O-ring gasket follows:

The O-ring gasket is formed from a compound with a Durometer Shore "A" 90 hardness and is sized according to the tube fitting/boss relationship. Again the sealing quality is the result of the distortion and the gland relationship. The distortion is caused by the pressure created by thread engagement. The gland will be fully filled and the O-ring at maximum distortion when the tube fitting and the tube fitting boss are in metal to metal contact. The sealing of the positioning bulkhead fitting differs from the non-positioning fitting in that pressures above 1000 psi require the use of an anti-extrusion backup ring to prevent extruding under the threaded nut. Pressures below 1000 psi, use a nut that is not recessed for the anti-extrusion backup ring. The installation of these O-ring gaskets is fully covered in AND 100064 and MS 33566. It is recommended that these drawings be studied and their provisions adhered to for all gasket installations.

## Evaluating Leakage

Here is a practical approach to deciding whether a hydraulic unit should be replaced and some suggestions for realizing better service life from O-rings.

Units such as landing gear, flap drive, that operate only a few times during flight should be considered satisfactory, if upon inspection after

flight, only a few drops of fluid have collected. Any large increase in the leakage rate from one flight to the next should be viewed with suspicion, however.

The above units should be allowed some leakage while the airplane is parked, say a few drops overnight. Here again a large increase in leakage over a period of time would be the signal to remove the unit and check the seals.

**Power Control Actuators.** For power control actuators, the present specification is not actually a good criterion for allowable leakage. In laboratory work Lockheed has revised the procedure of measuring drops per minute, since operation is more or less continuous. Present testing procedure is to continue the tests until leakage reaches five drops per minute from a rod seal. At this rate, the amount of fluid that would collect in an eight-hour flight would be approximately 120 cubic centimeters. While this quantity could result in a considerable wetting of surfaces exposed to the leakage, it is not particularly detrimental to the operation of the hydraulic system or the airplane. It should be borne in mind however, that excessive fluid collecting in an area where ignition could occur is a hazard which must be avoided. If such a hazard does exist, it is certainly preferable to wipe up the excess fluid and to check the reservoir level occasionally than to remove and replace power control actuators.

## O-Ring Identification

A replacement O-ring should be the same type and size as the original ring. For example, a hydraulic system O-ring will deteriorate rapidly if it's used in some engine and fuel systems. Likewise, a ring that's too large or too small may not seal properly, may create too much friction and may be difficult to install.

Selecting the correct type and size replacement O-ring can be a bit of a problem, especially when the job entails choosing between AN standards, MS standards, manufacturers standards, color-coding, no color-coding and stock numbers which once were something. They aren't anymore because they have been converted to some other number—or maybe they haven't been—yet.

**Charts available—**Lockheed Aircraft Corporation has attempted to solve this problem, in part at least, by preparing some reference charts. NASC has reproduced these charts and is distributing them to all Crossfeed addressees. Additional copies may be obtained by writing Commander, Naval Aviation Safety Center, NAS Norfolk 11, Virginia, Att: Safety Education Department.



## Repeated Squawks

IF YOU experienced a flat tire on your car, what would you do about it? Although you can't deny that there are those who would, not many of you would pump the tire up just to see if it would go flat again. Most of you would put on the spare, then have the flat inspected and repaired.

An airplane shock strut that goes flat isn't much different from a tire, except that oil as well as air is added to the strut. In the case of the tire, when it gradually goes flat there is a cause, normally described as a leak.

Couldn't you deduce that if an airplane shock strut were continually going flat, there also must be a reason? And isn't it your job to find the reason and effect the repair?

All too often some fall short in responsibilities in this regard. For example, during a single two-week period, one aircraft had its right main landing gear strut go flat 13 times.

The flight crews reported the flat strut in the log each time it happened, and on all except the last one, the stock "fix" report written by the maintenance crew was either "serviced with air and oil" or just plain "serviced." The fourteenth and final action noted was, "replaced strut seals."

Here's another case. One airplane experienced 10 delays and one change of equipment in two days because of a leaking left main gear strut. One air valve and seal were replaced, but to no avail. Finally, the strut seals were replaced and this corrected the difficulty.

If the strut fluid is leaking at the O-ring seal area, no amount of air valves or valve seals will correct this situation. Early strut seal replacement is the only action that will nip this type of squawk in the bud.—*Flight Safety Foundation*

# HEADMOUSE

Since the days of Ghengis Khan it has been customary to respect whirling blades. Propeller blades demand even a greater respect.

## Prop Tip Painting

Dear Headmouse:

This squadron's monthly Safety Council Meeting generated several questions about the possibility of improving present yellow prop-tip markings on the P2V-5F. The white-red-white markings observed elsewhere seem to be an improvement. The use of luminescent paint was suggested as an improved peacetime marking providing additional safety at night.

The aid of the Safety Center is solicited in this matter. Please forward comments or cite literature, as appropriate, bearing on this subject.

C. E. OLSON
CO, VP-22

► Requirements for Military Specification, Colors, Exterior, Naval Aircraft (MIL-C-18263C (Wep) contains the information you desire. Paragraph 5.5.3.1 is quoted as follows:

"*Blades.*—Blades shall be painted as shown in Figure 25. Propeller blades on multi-engined planes shall be painted on both sides from tip to three inches from the tip with insignia white Federal Standard Color No. 17875, followed by a six-inch strip of insignia red ANA Color No. 509, followed by another three-inch strip of insignia white. The remainder of the blade shall be colored black, Federal Standard Color No. 37038, except this may be eliminated on blades where both the

**Mail your questions to:**

**HEADMOUSE**

**U. S. Naval Aviation Safety Center**

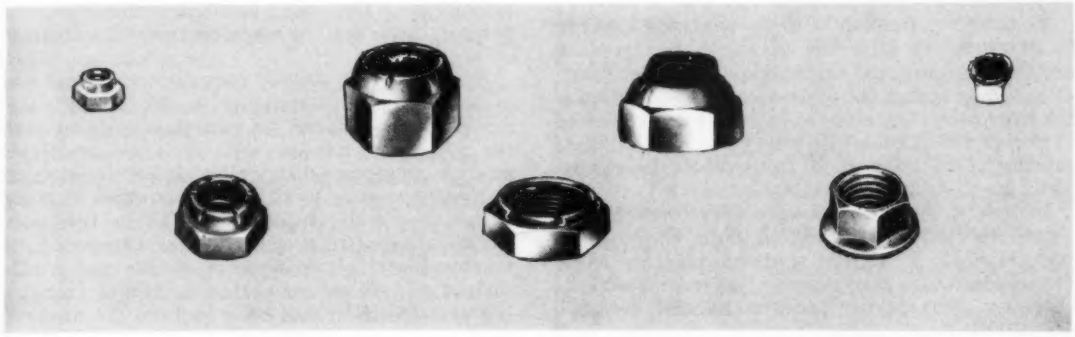
**Norfolk 11, Virginia**

following conditions are met: (1) corrosion protection is not required, and (2) the blades are so situated as to produce no glare or excessive brightness in the pilot's or co-pilot's eyes; e.g., in cases where the blades rotate in a plane aft of the pilot's seat.

If the blades are so situated as to produce glare or excessive brightness in the pilot's or co-pilot's eyes, the insignia red and insignia white shall be replaced by bright red and insignia white, Federal Standard Color Nos. 31136 and 37875, respectively, on the rear face of the blades only. Propeller blades on single engined planes shall be painted on the front side in the same manner as for multi-engine blades; the rear face, however, shall be colored black, Federal Standard Color No. 37038."

Very resp'y,

Headmouse



## Stop Nut Re-Use Problem

Dear Headmouse:

By chance we recently saw the Nov '61 APPROACH. Much to our surprise we found one of our products discussed at some length on Page 37.

The question of re-using a self-locking nut has always presented some problems. We would not bother you with this letter except for the fact that the information presented in the article is rather seriously obsolete. Since 1954 ESNA has used nylon locking collars instead of fiber, in all of the insert type nuts which we manufacture. One of the great advantages of nylon is its wear resistance and high reusability factor which this offers. Unless the bolt is damaged, and in turn damages the nylon collar when the nut is removed, a nylon insert type of Elastic Stop nut can be re-used safely fifty times or more.

This is far better than the performance of almost any type of all-metal nut (and we make those too) and, of course, the nylon insert never galls or damages the bolt threads.

I have no idea how important this matter may be to you and to maintenance personnel—but the article offered no indication that there is a newer and greatly improved insert type Elastic Stop nut, which in turn will provide a far greater reliability and safety factor in terms of resistance to vibration and re-use.

BRUCE F. LINCK
Elastic Stop Nut
Corporation of America
Union, New Jersey

► Safety Center recognizes the fact that there are many newer and greatly improved types of Elastic Stop nuts and other similar nut/bolt retention devices. Although the information presented in the APPROACH article may appear seriously obsolete, fiber lock nuts are still in the supply system and will be used by the mechanic for some years to come. In addition, it is agreed that the use of self-locking nuts in aircraft manufacture is permitted and not a dangerous practice in itself.

However, for several years self-locking nuts have been used at nut and bolt combinations in critical flight or powerplant control installations in contradiction to Military Specifications. Accident reports concerning failure of self-locking nuts to lock properly indicate that often times inadequate care is taken to insure the self-locking feature has not lost its retention qualities. Lack of clear, consistent instructions on re-use of these nuts, particularly at joints in control systems at single attachments or where loss of the bolt would affect safety of flight, has contributed to the general laxity in their re-use. Should variances from specifications be permitted and self-locking nuts used in critical points in flight or powerplant control linkages, the Safety Center endorses a policy of prohibiting the re-use of self-locking nuts at these locations.

The last sentence, paragraph IV of the Service Engineering Report enclosed with your letter appears to agree with our position, in that there are locations where re-use of self-locking nuts will not provide the necessary reliability.

Very resp'y,

Headmouse ●

# NOTES AND COMMENTS ON MAINTENANCE

## Explosive Hazards in Titanium

A HALF-MILLION dollar fire recently occurred at Wright-Patterson AFB, and was caused by sparks from a mechanic's wrench igniting a pile of oil-soaked titanium chips.

To those not familiar with the explosive hazards in titanium, the chips and dust from this product are very unstable and oxidize rapidly. When damp or wet, they absorb the oxygen in water and release the hydrogen. The released hydrogen is extremely explosive and if set off, it will ignite the titanium, causing it to burn at a temperature exceeding 5000° F.

In view of the hazards involved, extreme caution should be used in handling titanium chips, turnings, or dust. When wet or damp, they are more dangerous than magnesium. It is imperative, therefore, that proper scrap containers be used for titanium to avoid injury to personnel and damage to property.—*NAA Service News*



## Engine Analyzer Trainer

A NEW test bench installation has been developed by NAMTraGru Det 1056 (P2V-5, -5F), Brunswick, Me., one of the 86 Detachments of the Naval Air Maintenance Training Group which has its headquarters at NAS, Memphis.

Clifford P. Nelson, ADRC, Carl Linza, AECS and Roland D. Martin, AE1, electrically coupled a Sperry Airborne Engine Analyzer to a Greer Ignition Test Bench. The necessary parts were salvaged from stricken aircraft.

One of the most difficult tasks in training personnel to use the Engine Analyzers effectively is the familiarization with pattern interpretation. Only by constant repetition and practice can maintenance personnel effectively learn to interpret the troubles which the Analyzer is projecting on its scope. In the new installation, ignition malfunctions of various types can be induced into the Greer Test Bench, which functions as the engine ignition system. This combination then permits all types of analyzer patterns to be reproduced in the classroom to provide the necessary practice and illustration of the conditions which maintenance personnel will encounter while actually using the airborne installation. Remote control switches located in the rear of the analyzer cabinet permit the instructor to remain in front of the class with the analyzer, while the test bench and its distracting influence can be placed at the rear of the classroom. Both of these units, working together, permit the instructor to duplicate the waveforms peculiar to a particular ignition malfunction and portray those desired waveforms on the analyzer scope.

Because of the ease of removal and installation of the analyzer components in the cabinet, this combination unit can be advantageously utilized for other purposes as well. It is not restricted solely to classroom instruction. In-service aircraft analyzer components which are suspected of being defective, can be readily installed in this unit, thereby permitting maintenance personnel to troubleshoot their equipment on the test bench, instead of the time consuming method of exchanging parts between operating units in the aircraft.

## Not Trivial

THE ever-present problem of fuel contamination was discussed when one of the members related a recent occurrence involving a multi-engine aircraft which flew to a northern NAS and remained overnight on the parking ramp because hangar space was not available. Overnight temperatures were well below zero and the following day the engines were preheated, turned up and the preflight inspection was performed by the aircraft crewmembers. The plane commander accepted the aircraft for flight and during the pretakeoff engine check discovered a discrepancy in the aircraft fuel system.

Further inspection revealed contaminated fuel in a main tank and a fuel line filled with frozen water and debris. Also the fuel tank drain valve had been improperly installed and it was not functioning as advertised. In many instances, pilots are forced to rely upon the integrity of their crewmembers and maintenance personnel.

In most cases pilots feel secure in this reliance because the personnel involved have proven themselves many times to be completely dependable. However, all pilots are reminded of their responsibilities and that no precaution is to be considered so routine or so trivial that it warrants being slighted or disregarded completely.

—*NAS Minneapolis.*

## Bad Practice

WHILE checking the Doppler Navigation equipment, a technician contacted 3000 volts and was knocked unconscious. This connector was found as depicted—certainly not connected to take 3000 volts.

The Klystron tube requires fairly frequent replacement. It comes without a connector installed because of the many aircraft models in which it's used. Because the shop does not have a quantity of these connectors on hand, the practice has arisen of cutting off the old connector and reinstalling it on the new klystron.

A correctly installed connector of this type should be potted and a metal sleeve installed. Since the potting is almost impossible to remove from a used plug, and the plug restored to reinstallable condition, the practice arose of skimping on the potting in the first place. The whole installation process deteriorated to the point that plugs were being installed as depicted in the photo. It almost killed a man!—*Anymouse*

## HSS-2 Shocker

REPORTS indicate aircraft handlers are receiving severe electrical shocks when touching the HSS-2 airframe.

Investigation revealed the lack of continuity between the ground wire and tail wheel yoke assembly due to paint on the mating surfaces.

Removal of paint from these surfaces is recommended.

## Fumbles

"FUMBLING the ball is not always a serious matter, but when it occurs in maintaining high performance aircraft, the result is usually costly" —says Major Rex Riley, USAF's fictional safety officer.

In this case the primary cause was maintenance error . . . the oil strainer had been improperly assembled at the last periodic inspection and improperly cleaned at the last post flight inspection. Result—seal failure, loss of oil, loss of thrust and loss of aircraft.

Supervisory error—Failure to check qualifications of new personnel before assigning duties, failure to use work cards and failure to adhere to established inspection procedures.

"Better ball handling in these areas might have made a gain instead of a loss." ●

## Electrical Quiz

1. How many circuits are there in an Edison Fire Detection System and what are they?

2. If two coulombs of electrons charge a capacitor to two volts, the capacitance is:
(a) 6.28 microfarads; (b) 1 microfarad; (c) 6.28 farads; (d) 1 farad.

3. If a basic ammeter has a 0-1 ma. movement and an internal resistance of 50 ohms, to increase the full scale deflection to 10 ma., the value of resistance to be placed in parallel with the meter would be:
(a) .0555 ohm; (b) .555 ohm; (c) 5.55 ohms; (d) 55.5 ohms.

4. The type of diagram that is consulted to find location and interconnection of parts is called a:
(a) schematic diagram; (b) master diagram; (c) wiring diagram; (d) pictorial diagram.

5. The Naval Aeronautic Publication Index, NavWeps 00-500:
(a) contains a list of parts available for issue in supply;
(b) contains a list of equipment and material necessary to place an activity in readiness condition;
(c) lists publications currently in effect;
(d) is revised annually.

6. It is dangerous to touch a burned-out selenium rectifier when it is hot because:
(a) some of the selenium compound could be absorbed through a skin burn;
(b) direct current could cause shock;
(c) selenium dioxide fumes could be liberated;
(d) all the above are correct.

7. The principal hazard(s) when handling and charging batteries is/are due to the damage of:
(a) electrical shock; (b) asphyxiation; (c) acid burns and explosion; (d) acid burns and asphyxiation.

8. When fighting an electrical fire, you should use:
(a) foam; (b) soda and acid; (c) carbon dioxide; (d) carbon tetrachloride.

9. Electrical shock is fatal when of current is passed through a person from hand to hand for one second or more.
(a) .10 ampere; (b) .01 ampere; (c) 1 milliampere; (d) 10 milliamperes.

10. Material condition tags which indicate equipment is destined for salvage are colored:
(a) white; (b) yellow; (c) blue; (d) green.

### Answers

1. Three. a—indicator circuit; b—sensing element circuit; c—control unit circuit. 2. (d) One farad. 3. (c) 5.55 ohms. 4. (b) Master diagram. 5. (c) Lists publications currently in effect. 6. (a) Some of the selenium compound could be absorbed through a skin burn. 7. (c) Acid burns and explosion. 8. (c) Carbon dioxide. 9. (a) .10 ampere. 10. (b) Yellow.

**Here's the statement of an AD1 following the loss of a helicopter after a maintenance error. The mech assumes full responsibility for the accident—but was he really at fault? Make your own conclusion after reading this**

REVEILLE was at 0600. I ate breakfast and mustered our detachment. We then took both helos to the flight deck, preflighted them and turned them up for a warm-up and ground check. We made a 1R2 hop to the beach with a captain and jg as passengers.

We returned to the ship and I helped fold 65 down for an engine change. The time now was 1100. We disconnected the engine and the blades on the flight deck next to the island structure. At 1400 we were taken below for completion of disassembly of the engine and helo. At 1445 we were ordered to put back together what had been taken apart. (A flood disaster on the beach prompted the call for the chopper—Ed). Informed that it would take about four hours to do so, the decision was made to complete the engine change.

We then went at our work taking turns to eat supper as work continued. We did our best to do a job that usually takes four days. At about 0430 we installed the new engine, connected fuel lines to the carburetor so it could soak. We policed the area and went to bed. The time was 0500.

At 0830, I was called to the phone and asked why no one was at work on the engine. I held reveille on the crew and we turned to. We finished connecting everything up and I inspected the engine prior to turn-up. It now was 1030. After turn-up we removed blow-out plugs, retorqued the fan, installed the long and short shafts. This was completed about 1500. Because the old blades were chipped we decided to install new blades. These were ordered from supply. In the meantime we canned our old engine and carburetor. We secured for supper and decided to install the new blades the first thing in the morning.

After supper we showered and were ready for bed. At 1800 I got a phone call the blades had to be installed that night. We went down to the hangar deck and installed the blades, completed the job and secured the plane on no. 3 elevator. The time, 2100. After turning in I was called to move the helo from the elevator to the flight deck. Back to bed at 2230. Up at 0600 the following morning to adjust idle mix, complete turn-up and to track blades. We changed oil, gassed up and inspected the engine again for loose parts, oil leaks, tools and signs of discrepancies. About 0930, after tracking blades we launched 65 for its first hop. The second hop I checked the engine over again. No trouble was noticed. The third hop was its last.

I was sent with the accident board to investigate the cause. I found the bolt from the throttle linkage missing. It was my conclusion the cotter pin had been left out and the nut had backed off permitting the bolt to drop out. I had inspected this engine installation three times. I am sure I am at fault for missing this discrepancy.

The accident board concurred but pointed out the accident could have been prevented in several ways:

- Had the crew used a major inspection form for a check-off list for the engine installation, the error might have been discovered before any damage was done.
- Had there been available a fully qualified HUP mechanic, who had not performed the work, to inspect the work done, the accident would very likely have been prevented.
- Had the crew worked shorter hours, their work would probably have been flawless.

Should necessity dictate expeditious completion of aircraft maintenance, and the detachment is unable to maintain proper supervision on the work being performed, the ship's company should augment where necessary, said the reviewing authorities.

*As the Chief says*—"Clearly another case of the more hurried you are the more behinder you get."

# MURPHY'S LAW*

*If an aircraft part can be installed incorrectly, someone will install it that way!

AIRCRAFT accidents involving maintenance factors have been on the increase during recent weeks.

*Example*: A TV-2 swerved off of the runway after a short takeoff roll and struck an MB-6 crash vehicle. Three men in the vehicle were killed and one was seriously injured.

*The cause*: the starboard wing had been received and installed with the aileron cables *rigged in reverse.* Overhaul and repair quality control personnel inspected the wing, air station maintenance personnel installed it, air station quality control personnel inspected it, and finally, the plane captain overlooked the reversed control before the flight.

Of significance is the fact that maintenance errors occur on aircraft that have been in the Navy's inventory for years. Complexity or lack of information cannot be considered as a causal factor. The accidents would not have occurred if standard published maintenance procedures and inspections had been carried out. All maintenance and flight personnel must remain alert, vigilant and meticulous to detail to prevent a "Murphy's Law" incorrect installation from occurring. *NAS-Willow Grove APC*

PARTICULAR care should be taken when reconnecting adjacent electrical leads of fuel and lube lines to prevent interchanging them. Every effort is made when designing an engine to eliminate such possibilities by using different sized fittings, but sometimes, for one reason or another, this isn't feasible.

For example, an afterburner-ignition-lead-connection is made near the main sparkplug on J79 engines. The connectors on the two leads are the same size, and, particularly, if the leads have not yet been secured with clamps, they may be switched. An attempt to start an engine on which such a switch has been made will be unsuccessful, and time-consuming trouble-shooting may result.

Tagging the lines prior to disconnecting them, or comparing the connections with a correctly connected engine are two ways by which you might eliminate this type of occurrence.—*GE Jet Service News*

THE SNB was downed for erratic fuel quantity indications. No discrepancy was found. On the next flight, an extended cross-country, the pilot noted the same gripe. He timed his use of each tank carefully. He found that after 37 minutes the main tanks went dry and he ran for over an hour on the AUX. After landing his suspicions were confirmed—the fuel selector valve was installed 180 degrees out. AUX tanks MAINS were connected vice versa.

During maintenance the selector valve handle had been changed. The mech had turned up the aircraft and tested to see that OFF was in the right place. With the nose tank empty this check could not determine what was desired.

The procedure now used is to put a few gallons in the nose tank and check to see that it is in the correct position on the selector.—*Contributed by ASO NAS Cecil*

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WHEN replacing Turn and Bank Indicator (Part No. 1722-2BC-B2-1 Stock No. R6610-663-4135-VIZB) in an FJ-4, the Air Pressure line was inadvertently hooked to the vacuum port of the Indicator. A similar incident occurred when replacing an Indicator (Part No. 1722-1BAB1-1 Stock No. R6610-253-3547-VIZC) in an F8U-1.

Both Indicators have a pressure port and vacuum port unmarked. Unless prior experience or knowledge of inner construction of Gyro Rotor is known by the technician, this line can be installed INCORRECTLY, causing unreliable operation of Indicator due to low RPM of rotor. The two ports are made available so that this Indicator can be used on a Pressure (Jet Aircraft) or Vacuum (Reciprocating engine) system.

There have been two incidents of this type in this Command. Present maintenance personnel are aware of the condition but future replacement personnel will not be. *Contributed by VU-5.* ●

# Lift / Drag

*The following letter, from LT L. L. Parker of VT-31 NAS Corpus Christi, is presented because of its timeliness and thought provoking discussion on the subject of instrument landing minimums.*

"ONE area of flight safety which has been long neglected by the Navy is that of improving the terminal area. Specifically, I feel that the Navy has lagged far behind the rest of the major aviation activities in the field of runway approach lighting. Commercial aviation interests, on the other hand, have made a major effort in this regard. Particular emphasis has been placed on the improvement of the approach lighting system associated with the instrument runway at individual airports and, where funds permit, on other runways.

"With the present emphasis on all areas of flight safety in naval aviation, the high monetary cost of modern aircraft and the number of fatal accidents which occur, how can we establish *Precision Approach Radar* (PAR) minimums of 100-¼ for multi-piloted reciprocating aircraft and 200-½ for single-piloted jet aircraft on runways where approach lights are nonexistent unless such action is dictated by operational necessity? The lowest PAR minimums which have been approved by the FAA for multi-piloted reciprocating aircraft is 200-½ and these are, in most cases, raised to 300-1 when high intensity runway approach lights are not available. PAR minimums for turbojet aircraft engaged in scheduled airline operation are, for the most part, 300-¾. Minimum of 200-½ have been authorized for six airports in the United States on a test basis only, predicated upon the simultaneous operation of both Precision Approach Radar and all components of the ILS system. (High intensity approach lights are considered an integral part of the ILS system.) These aircraft incidentally are multi-piloted.

"At the present time our operating instructions do not preclude pilots of multi-piloted aircraft from commencing an approach even though the reported weather is below minimums. In theory naval aviators should not execute approaches when minimum weather exists unless such action is dictated by operational necessity or in an emergency. In many situations the pilot's better judgment tells him he should proceed to his alternate without executing an approach. In actual practice, however, professional pride, a can-do attitude or even get-home-itis causes many pilots to execute take-a-look approaches to airports where the reported weather conditions are below PAR minimums.

"Once a PAR is started there is a temptation to carry it to minimums, or even below, in an attempt to get down. Take-a-look approaches should be permitted only on runways of adequate length equipped with high intensity approach lights.

To correct the situation we should:

a. Improve our weather observation and reporting procedures to include the Runway Visual Range concept and ensure that up-to-the-minute observations are available to approach controllers and pilots.

b. Revise our operating procedures to preclude pilots from commencing approaches when reported weather conditions are below minimums unless such action is dictated by operational necessity or in an emergency.

c. Establish a standard U. S. configuration "A" runway approach lighting system along with adequate obstruction clearance and runway length as a prerequisite for minimums of 100-¼.

d. Raise all other minimums for flight other than operational to 200-½ for propeller-driven aircraft and 300-¾ for turbojet aircraft where this system is not installed, until such time that RVR equipment can be installed. It is believed that the saving realized from the decrease in aircraft accidents will far outweigh the initial cost of installation of the above mentioned runway approach lighting systems. In addition, it is believed that the all-weather capability of our shore stations and shore-based fleet squadrons will be greatly enhanced not to mention the improvements in pilot morale."

*The foregoing is both timely and of current interest to* APPROACH *readers since the Navy's bible on instrument requirements, clearance and approach minimums (OpNav Inst 3720.2A) is presently undergoing revision.* ●

# . . . DUMB ANIMALS?

SAFETY is a funny thing. Dumb animals take to it naturally; it is born and bred right into them. But man, supposed to be way on top in the social order, often thinks that only "sissies" practice safety.

It is said that beavers always detail one of their number to watch out and warn the rest of the animal tree choppers when the tree is about to fall. Yet, how many times do experienced drivers fail to take similar precautions and ask for assistance when moving aircraft into a tight spot!

Ducks fly in a V formation for safety, and it is said that if any source of danger is spotted a scout flies out to investigate. Yet how blindly we human beings often walk, drive or fly into danger.

If you have ever gone crow hunting you know that it is almost impossible to get a good, close range shot at the flock. Why? Because they have sentinels placed at advantageous spots and these warn of man's approach.

A woodchuck always digs two, three or more holes to his burrow, so that if an enemy comes after him through one he has a choice of backdoor exits.

A wren won't build its nest in that nice little bird house you hang up in the back yard unless the entrance is so small that it will keep out larger birds.

Many of us remember back in the horse and buggy days when you couldn't whip Old Dobbin into crossing a rickety bridge that looked unsafe for him.

Now it never occurs to us to call an animal a coward or "sissy" just because it takes all these precautions. In fact, we give it credit for being pretty smart. Yet many of us scoff at the safety precautions taken by man.

It makes one wonder sometimes if we aren't really the ones to be placed in the "dumb animal" class.

*NSC Fleet Safety Contest Bulletin*

It's not the wrench that slips and strikes
Or the circuit you thought was dead;
It's not the gear doors that grab your hand
Or the ladder with the slippery tread;
It's not the wing that you fall off,
So please don't be misled,
The thing that causes the accident is YOU—
Not using your head.